SITE INVESTIGATION
WORK PLAN

Fansteel, Inc.
Number One Tantalum Place
North Chicago, Illinois

Prepared by
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EPA Region 5 Records Ctr.
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EXECUTIVE SUMMARY

On behalf of Fansteel, Inc. (Fansteel), Carlson Environmental, Inc. (CEI) prepared this *Site Investigation Work Plan* for the Fansteel North Chicago facility (site). The Vacant Lot Site, a Superfund site, is located adjacent to and west of the Fansteel North Chicago facility. The activities detailed in the *Site Investigation Work Plan* are intended to comply with the request from the United States Environmental Protection Agency (EPA) to conduct an investigation to identify any potential contaminant plumes which may be impacting the near surface contamination detected at the Vacant Lot Site, and to collect additional samples from Pettibone Creek, which flows across the Vacant Lot Site in a north to south direction.

This *Site Investigation Work Plan* has been prepared by CEI on behalf of Fansteel to detail the proposed soil, ground water and sediment sampling to be conducted by Fansteel. This *Site Investigation Work Plan* is being submitted for EPA review and approval. Upon receiving approval of this work plan, Fansteel intends to conduct the Site Investigation. Upon completion of the Site Investigation, a *Site Investigation Report* detailing the results of the Site Investigation will be prepared and submitted to the EPA.

Numerous site investigations have been conducted at the Vacant Lot Site that also included sediment sampling in Pettibone Creek. The results of the investigations, which included the collection of soil samples and sediment samples from Pettibone Creek, indicated the presence of elevated concentrations of heavy metals, trichloroethene (TCE) and polychlorinated biphenyls (PCBs).

The proposed Site Investigation includes the emplacemnt of 32 soil borings and the installation of 10 ground water monitoring wells on or along the Fansteel property. The borings and monitoring wells will be sampled for volatile organic compounds (VOCs) and selected metals. Additionally, twelve sediment samples will be collected from Pettibone Creek and sampled for selected metals, cyanide and PCBs. The metals analyses will include analysis for the presence of tantalum (Ta), a specialty metal used by Fansteel.

The sampling results from the Site Investigation will be compared to established generic remediation objectives. If contaminant concentrations are detected above these remediation objectives, Fansteel may propose alternative site-specific remediation objectives using a risk-based type of analysis. If significant soil contamination or a ground water contaminant plume is detected, an additional investigation may be performed to delineate the contaminant plumes.

Upon completion of the proposed investigation(s), if the results indicate that near surface contamination at the Fansteel North Chicago facility is significantly impacting the adjacent

Vacant Lot Site and remediation at the Fansteel North Chicago facility is appropriate, Fansteel will research viable remediation alternatives and prepare an Engineering Evaluation and Cost Assessment (EE/CA) Report, if necessary.

1.0 INTRODUCTION

1.1 Purpose of the Site Investigation

On behalf of Fansteel, Inc., Carlson Environmental, Inc. (CEI) prepared this *Site Investigation Work Plan*. This work plan details a proposed site investigation at the Fansteel North Chicago facility and additional sediment sampling in Pettibone Creek. The activities detailed in the *Site Investigation Work Plan* are intended to comply with the request from the United States Environmental Protection Agency (EPA) to conduct an investigation, as outlined in a letter to The Fansteel Corporation dated June 17, 1997.

As outlined in the EPA's letter, the proposed Site Investigation is to accomplish the following two goals:

- Identify the nature and extent of potential contamination on the Fansteel facility, including any potential contamination that may be contributing to the ground water contamination identified at the adjacent Vacant Lot Site (especially potential sources of trichloroethene); and

- Conduct additional sampling of the sediments of Pettibone Creek to determine the nature and extent of the sediment contamination.

1.2 Project Background

Numerous site investigations have been conducted at the Vacant Lot Site which is located adjacent to and west of the Fansteel North Chicago facility. Pettibone Creek flows across the Vacant Lot Site in a north to south direction. In addition to previous investigations, Ecology and Environment, Inc. (E&E) conducted a site assessment at the Vacant Lot Site in 1994. The results of this investigation, which included the collection of soil samples and sediment samples from Pettibone Creek, indicated the presence of elevated concentrations of heavy metals, trichloroethene (TCE) and polychlorinated biphenyls (PCBs).

In 1997, E&E conducted an Engineering Evaluation/Cost Analysis (EE/CA) for the Vacant Lot Site under contract with EPA. The EE/CA included a historic review of the site, additional soil, ground water and sediment sampling at the Vacant Lot Site, a feasibility type analysis of potential remediation alternatives, and a cost analysis for various remediation strategies.

It is alleged in the EE/CA that historically, the Vacant Lot Site has been used for waste disposal by industrial properties in the vicinity of the Vacant Lot Site. Additionally, the EPA believes that potential contamination at the Fansteel North Chicago facility may have impacted the ground water at the Vacant Lot Site. Outfalls from the Fansteel North Chicago facility discharge to Pettibone Creek. The EPA also believes that historic discharges from these outfalls may have impacted the creek sediments.

In the letter to The Fansteel Corporation dated June 17, 1997, the EPA has requested that Fansteel conduct an investigation of the Fansteel North Chicago facility to identify any potential contaminant plume which may be impacting the near surface contamination detected at the Vacant Lot Site and to collect additional samples from Pettibone Creek. This *Site Investigation Work Plan* has been prepared by CEI on behalf of Fansteel to detail the proposed soil, ground water and sediment sampling to be conducted by Fansteel. This *Site Investigation Work Plan* is being submitted for EPA review and approval. Upon receiving approval of this work plan, Fansteel plans to conduct the Site Investigation according to the project schedule included in Section 5.3.

2.0 GENERAL SITE INFORMATION

2.1 Site Description

The Fansteel North Chicago facility is located at Number One Tantalum Place, approximately two miles east of the intersection of Martin Luther King Jr. Street and U.S. Highway 41, in North Chicago, Lake County, Illinois (refer to Figure One in Attachment A). The site is bounded by the North Chicago Refiners and Smelters facility to the east, Martin Luther King Jr. Street and the Federal Chicago plant to the south, the Vacant Lot Site to the west, and a the Elgin, Joliet & Eastern (EJ&E) Railroad to the north.

The site consists of an older plant complex located on an approximately eight-acre parcel. There are two brick buildings on the site; the boiler house and the main production building which is comprised of multi-story and multi-use inner buildings. In addition, a transite building and a few aluminum buildings are present on the site. Total gross floor space is reported as 325,500 square feet.

The portions of the property not covered by building are generally asphalt- or concrete-paved and are used as parking lot areas or access ways. Two empty large upright above-ground tanks are located at the northern end of the property. A railroad spur is located just inside the eastern

edge of the site, and an elevated railroad siding is located just south of the above-ground tanks. The entire site is enclosed by security fencing, and there is some vegetation, consisting of grass and bushes, between the office area and Martin Luther King Jr. Street.

The site topography is essentially flat, although on the east site the site is raised near the fence line, sloping down into the parking lot. The building is raised compared to the parking lot, and the railroad spur on the east side is several feet below the site grade. The railroad property north of the site slopes steeply downwards toward the site.

The site configuration is depicted in Figure Two in Attachment A.

2.2 Site Physiography

In November 1993, Geraghty & Miller, Inc. conducted a ground water investigation at the Vacant Lot Site which focused on shallow ground water (to a depth of 14 feet below ground surface (ft bgs)). The investigation was detailed in a report, Groundwater Investigation, Stack Property, North Chicago, Illinois dated June 1994. The information regarding the site geology and site soils is summarized from this report prepared by Geraghty & Miller, Inc.

2.2.1 Site Geology - The general regional geological information indicates that unconsolidated deposits in the vicinity of the site consist of glacial lake deposits and glacial till. The deposits consist of silt, clay and sand deposits accumulated on the floors of glacial lakes. These strata are reportedly underlain by glacial till. Generally, the glacial lake deposits range from 10 to 25 feet in thickness with the underlying glacial till ranging from 50 to 100 feet in thickness.

2.2.2 Site Soils -Based on the borings advanced by Geraghty & Miller, Inc. during their investigation, the soil at the Vacant Lot Site generally consisted of 1.5 to 5 feet of black sandy fill resembling slag or fly ash. Tan to gray silty clay containing discontinuous lateral silty to gravel sand deposits is located beneath this fill material to a depth of approximately 10 ft bgs. Grayish silty clay with several discontinuous lateral thin sand and gravel seams was present from approximately 10 to 20 ft bgs. It is anticipated that the soil at the Fansteel North Chicago facility will be similar to the soil types encountered by Geraghty & Miller, Inc. during their investigation.

2.3 Site History

Vulcan Louisville Smelting Company (VLS) previously operated on the areas currently occupied by the Vacant Lot Site, the Fansteel North Chicago facility and North Chicago Refiners and Smelters. Based on a review of Sanborn Fire Insurance Maps, VLS is shown to occupy area of the Fansteel North Chicago facility on Sanborn Maps from 1921, 1917, 1924 and 1929. According to information provided by representatives of Fansteel, the Fansteel North Chicago facility was constructed in the early 1940s as the Tantalum Defense Company to supply tantalum need during World War II. The facility was sold by the Federal government to Fansteel in 1946. The Fansteel Metals Division and Fansteel VR/Wesson Foundry Division previously operated at the site. The main facility operations included the production of specialty metals and related products, in addition to foundry operations. Production activities at the North Chicago facility ceased in 1990.

2.4 Current Site Operations

The site is currently used by Fansteel, Inc. as office space for their corporate headquarters. Production related activities ceased at the North Chicago facility in 1990. The former plant buildings are primarily vacant and are routinely maintained, as necessary.

3.0 FOCUS OF SITE INVESTIGATION

3.1 VOCs

Elevated concentrations of volatile organic compounds (VOCs) were detected in the soil and ground water at the Vacant Lot Site. Fansteel has been asked to investigate the soil and ground water at the North Chicago facility to determine if there is a VOC soil and/or ground water plume that may be migrating on to the Vacant Lot Site. The number of sample locations and sample analyses proposed by Fansteel during this Site Investigation is discussed in the Sections below and summarized in Table One in Attachment A.

3.1.1 Soil - During the proposed Site Investigation, a total of 32 soil borings will be emplaced at locations across the Fansteel North Chicago facility to a depth of approximately 20 ft bgs. During the field activities the soil samples will be screened and visually classified. The sample from each boring which exhibits the highest potential for containing elevated VOC concentrations will be submitted for laboratory analysis. A second sample from each

boring may be submitted for VOC analysis in an effort to determine the vertical extent of contamination at each boring location, if applicable.

3.1.2 Ground Water -A total of ten ground water monitoring wells will be installed at the site and screened from approximately 10 to 20 ft bgs. Each well will be sampled for VOCs.

3.2 Metals

Elevated concentrations of various metals have been detected in the soil, ground water and Pettibone Creek sediment at the Vacant Lot Site. Fansteel has been requested to investigate the North Chicago facility's soil and ground water for metals, in addition to collecting additional sediment samples from Pettibone Creek.

Tantalum (Ta) is a specialty metal that was previously used at the Fansteel North Chicago facility. Results from previous Fansteel site investigations have demonstrated elevated concentrations of lead (Pb) and cadmium (Cd) present in portions of the site soils located at the norther end of the Fansteel facility. Therefore, all total metals analyses will consist of Ta, Pb and Cd.

3.2.1 Soil - A total of 32 soil boring will be emplaced at locations across the Fansteel North Chicago facility. The borings will be continuously sampled to a depth of approximately 20 ft bgs. During the field activities the soil samples will be screened and visually classified. The sample from each boring which exhibits the highest potential for containing elevated metals concentrations will be submitted for laboratory analysis of total Pb, Cd and Ta.

3.2.2 Ground Water -A total of ten ground water monitoring wells will be installed at the site and screened from approximately 10 to 20 ft bgs. Each well will be sampled for Pb, Cd and Ta.

3.2.3 Sediment - Sediment samples from two sample depths (0 to 6 inches and 6 to 12 inches) will be collected from six locations in Pettibone Creek. Each sample will be analyzed for the 23 total metals included on the target analyte list (TAL), in addition to total cyanide (CN) and total Ta.

3.3 PCBs

Polychlorinated biphenyls (PCBs) were detected in the sediment samples collected from the portion of Pettibone Creek on the Vacant Lot Site. Fansteel proposes collecting additional sediment samples from locations of the creek north and south of the Fansteel outfalls. Additionally, Fansteel proposes collecting sediment samples from a drainage ditch that is located north of and drains into Pettibone Creek. This drainage ditch appears to receive surface runoff from an adjacent transformer bank where staining is present.

3.3.1 Creek Sediment -Sediment samples from two sample depths (0 to 6 inches and 6 to 12 inches) will be collected from six locations in Pettibone Creek. Each sample will be analyzed for PCBs.

3.3.2 Ditch Sediment - In order to evaluate whether possible PCB-containing surface water runoff from the transformer bank has flowed into the ditch and then to Pettibone Creek, two sediment samples will be collected from the drainage ditch at depths of 0 to 6 inches and 6-12 inches below the drainage ditch bottom. These two samples will be analyzed for PCBs.

4.0 SITE-SPECIFIC SAMPLING PLAN

The Site-Specific Sampling Plan has been developed to determine if historic releases at the subject site are responsible for the soil and ground water contamination detected at the vacant property adjacent to and south of the subject site. The Site Investigation will include the emplacement and sampling of soil borings, and the installation, development, and sampling of ground water monitoring wells in addition to sediment sampling from Pettibone Creek and the drainage ditch located north of the Vacant Lot Site.

4.1 Preliminary Activities

All personnel involved in this project will receive the appropriate hazardous waste site worker training (29 CFR 1910.120). In addition, all personnel will be trained in general and site-specific health and safety procedures, as well as quality assurance and quality control procedures.

Prior to beginning the field activities associated with the Site Investigation, CEI will contact local underground utility locating services to identify any natural gas, electric, water, sewer, cable television, or telephone utilities that may be located at the site. In addition, CEI will have

an on-site meeting with site personnel to further determine the locations of any additional utilities such as sewers, pipes, water mains, steam tunnels, or other utilities not identified by the local underground utility locating services.

4.2 Sampling Locations

The proposed soil boring and ground water monitoring well locations are presented below and shown in Figure Two in Attachment A. The proposed sediment sample locations are detailed below and shown in Figure Three in Attachment A.

4.2.1 Soil - CEI determined the number of proposed sampling locations using a sample grid with 150-foot spacing. The grid, based with a random point of origin, produced 33 sampling locations. Since there is limited access and a subsurface water line and other buried utilities along the west property line, the westernmost sampling locations that were generated by the 150-foot grid strategy were shifted further west to the Vacant Lot Site (subject to access approval). One boring was eliminated due to its proximity to a 300,000 gallon underground reservoir located beneath the "Sintering Building." Additionally, several other sampling locations were moved to avoid drilling through building foundations unnecessarily. Each boring will be advanced and sampled continuously to a depth of approximately 20 ft bgs.

4.2.2 Ground Water - Ten of the soil borings will be converted to ground water monitoring wells. The seven boring locations located west of the subject site will be converted to ground water monitoring wells (six wells to evaluate the potential migration to the west and one well to evaluate the potential migration to the southwest). In addition, the boring located southeast of Metallurgical Building "B", the boring located east of the Butler All Steel Warehouse, and the boring located northeast of the Pollution Control Building will also be converted to ground water monitoring wells. This configuration will provide perimeter ground water monitoring locations with ten monitoring wells. Each well will be screened to intersect the near surface ground water between approximately 10 and 20 ft bgs.

4.2.3 Sediment - Sediment samples will be collected from Pettibone Creek at three locations along the north and south perimeter of the Vacant Lot Site. These sample locations are situated north and south of the portions of Pettibone Creek to which outfalls from the Fansteel North Chicago facility discharge to the creek. The sediment samples will be collected from two depths at each location, 0 to 6 inches and 6 to 12 inches below the creek bottom. Sediment samples will also be collected from the drainage ditch located north of the EJE railroad tracks, located north of the Vacant Lot Site and the Fansteel North Chicago facility.

Two sediment samples will be collected from the drainage ditch at the location indicated on Figure Three at depths of 0 to 6 inches and 6 to 12 inches below the drainage ditch bottom.

4.3 Sampling Methodology

All samples will be placed in clean glass jars with Teflon®-lined lids or septa. The samples will be maintained at a temperature of approximately 4° C in an insulated container. Upon completion of the site sampling, selected samples will be shipped to an accredited environmental analytical laboratory for analysis. The samples will be maintained under standard chain-of-custody procedures.

4.3.1 Soil - Thirty-two soil borings will be emplaced at the subject site based on the sampling strategy described above. The borings will be emplaced and sampled using a Geoprobe® Macro Core Soil Sampling System. These soil borings will be advanced using a truck-mounted Geoprobe® Model 6600 and GH-60 hammer. If any of the sampling locations are inaccessible using a truck, a Geoprobe® Model 5400 mounted to a Case® 1840 Bobcat® may need to be employed to complete the soil borings.

Thirty-two soil borings will be advanced to a depth of approximately 20 feet below ground surface (ft bgs). Soil samples will be collected from each boring using a 48-inch stainless steel sampling tube lined with cellulose acetate butyrate (CAB) sampling sleeves.

The borings will be continuously sampled and the geological material will be visually classified. Samples from any one boring will be assigned alphanumeric identification numbers based on the boring number, followed by the depth of the sample collected. The shallowest sample will be given the letter "A," the next "B," etc. (e.g., GP-2A, GP-2B).

After the soil samples were collected, any excess cuttings will be containerized (refer to Section 4.4 below for additional information), the boreholes will be filled with bentonite chips, and any borings emplaced through asphalt or concrete paving will be brought back to grade with cement.

All soil samples will also be examined for visual evidence of contamination and field screened using a flame ionization detector (FID) or photoionization detector (PID). The FID and PID are both an effective device for identifying areas where volatile and semi-volatile organic compounds (e.g. oils, solvents, gasoline constituents) may exist. However, it does not identify specific compounds or their concentrations.

Soil samples that will be analyzed for VOCs will be collected using a combination of the techniques described in Update III to SW-846, published June 13, 1997. All VOC sampling procedures employed will be consistent with Method 5035 of SW-846. In general, each soil sample will be divided into four samples sample containers: two containers will be unpreserved (one for VOCs and one for metals analyses), one will be preserved with methanol (for VOCs), and a fourth container will be preserved with a methanol and sodium bicarbonate solution (for VOCs).

4.3.2 Ground Water - Ten ground water monitoring wells will be installed to a depth of 20 ft bgs. These wells will be installed using a truck-mounted Geoprobe® Model 6600 and GH-60 hammer to drive 3.5-inch diameter well rods into previously completed boreholes. Each well will be constructed using stainless steel well screens and risers. Well screening and casing materials will be steam-cleaned prior to installation. Quartz sand will be placed around the screen to an elevation of 1 foot above the screen. a bentonite seal will be placed above the quartz sand to provide an impermeable seal in the borehole. In order to secure the wells, a stick-up or flush-mounted steel well box will be cemented in place over each well.

Prior to development and purging, the static water level in each well will be measured. Each of the monitoring wells will be developed approximately 48 hours after installation using stainless steel bailers and/or a surge/pump procedure, depending on the amount of water in each well. Each well will be purged and sampled using a stainless steel bailer. All sampling equipment will be cleaned with an alconox solution and rinsed with distilled water prior to use at each well. The individual collecting the samples will wear new vinyl gloves during the collection of each sample.

a minimum of three borehole standing water volumes and a minimum of three well standing water volumes will be removed from each well during the development and purging activities, respectively, unless the wells are bailed dry.

After purging, a ground water sample will be collected from each well using a stainless steel bailer for laboratory analysis. All VOC sampling procedures employed will be consistent with Method 5030 of SW-846. Ground water samples targeted for VOCs analysis will be placed in a 40 mL vial preserved with methanol. Ground water samples targeted for metals analysis will be placed in a 500 mL plastic bottle preserved with nitric acid. Prior to analysis, the lab will filter the sample using a 0.45 micron filter.

4.3.3 Sediment - At each proposed sediment sample location, the sediment samples will be collected using a stainless steel trowel or AMS stainless steel hand auger. The sediment sample will be retrieved from two sample depths, 0 to 6 inches and 6 to 12 inches below the creek or ditch bottom. All sampling equipment will be cleaned with an alconox solution and rinsed with distilled water prior to use at each well. The individual collecting the samples will wear new vinyl gloves during the collection of each sample. Each sediment sample will be placed in an unpreserved sample jar.

4.4 Decontamination Procedures

In order to preserve the accuracy of the sample results from the Site Investigation, CEI will employ the decontamination procedures for the sampling equipment listed below. These procedures are designed to prevent cross-contamination between samples collected during the Site Investigation. Additional decontamination procedures related to personnel and personnel protective equipment (PPE) are discussed in Section 8.5 of the Site Health and Safety Plan (SHSP) developed for the Site Investigation and included as Attachment E.

- A temporary decontamination area will be constructed and used during the Site Investigation field activities. All steam-cleaning activities will be conducted within this decontamination area. The decontamination area will be constructed to provide containment of the any water generated during the steam-cleaning activities.

- All "down hole" equipment will be steam-cleaned prior to beginning each boring. All The equipment which will be steam-cleaned includes Geoprobe® rods and sampler assembly, well screening and well casing materials.

- New Geoprobe® CAB sampling sleeves will be used for each sample interval.

- All samples collected for potential laboratory analysis will be placed into new, laboratory-supplied sample containers.

- The individual(s) handling the samples will change into a new pair of vinyl gloves prior to handling and collecting each sample.

Additional QA/QC samples, including duplicates, field and trip blank samples, will be collected and submitted for selected analyses, as discussed in Section 4.5 of the CEI QAPP (included as Attachment C). CEI proposes collecting duplicate samples in a ratio of at least

one duplicate sample for every ten samples submitted for immediate laboratory analysis. Field and trip blanks will be collected each day field activities are conducted.

4.5 Investigation Derived Wastes

During the Site Investigation, several different "investigation derived wastes" (IDWs) will be produced. The procedures for handling these IDWs are listed below.

- All soil cuttings generated during the boring and monitoring well installations will be containerized in 55-gallon steel drums. Additionally, any development or purge water from the ground water monitoring wells will be containerized in 55-gallon steel drums.
- All used Geoprobe® CAB sampling sleeves will be placed in 55-gallon steel drums.
- All decontamination water generated from the steam-cleaning activities will be containerized and transferred to 55-gallon steel drums at the end of each work day.
- Any PPE that requires disposal (i.e. sampling gloves, tyvek, filter cartridges, etc.) will be placed in 55-gallon steel drums.

All drums will be labeled and staged at the site in areas designated by Fansteel representatives. CEI will mark the contents and applicable dates on each 55-gallon drum using a grease marker or paint. Upon completion of the Site Investigation, and a review of the analytical laboratory results, CEI will assist Fansteel in arranging for the proper disposal of the drums in accordance with applicable rules and regulations.

4.6 Analytical Parameters

All soil, ground water and sediment samples will be analyzed using the U.S. Environmental Protection Agency's (EPA) Test Methods of Evaluating Solid Wastes, Third Edition, (SW-486) for one or more of the following parameters:

- VOCs using Method 8260;
- Arsenic by Method 7060, Lead by Method 7421, Mercury by 7471, Selenium by Method 7740 and the remaining TAL metals plus tantalum by Method 6010;

- Cyanide by 9012; and
- PCBs by Method 8082.

The laboratory procedures, quality assurance and quality control measures associated with the analytical methods are detailed in the Great Lakes Analytical Quality Assurance Program, included as Attachment D.

5.0 SITE INVESTIGATION PROJECT MANAGEMENT PLAN

This Project Management Plan contains a summary and discussion of the approach and objectives for conducting the Site Investigation at the Fansteel North Chicago facility. a schedule and the qualifications of key CEI personnel that will work on this project are also included in this Plan.

5.1 Objectives

The objectives of the Site Investigation are to determine the nature and extent of potential near-surface soil and ground water contamination at the Fansteel North Chicago facility. Additionally, the Site Investigation includes a characterization of sediment samples collected from Pettibone Creek at locations both upstream and downstream from Fansteel outfalls to Pettibone Creek.

The results of the investigation will be detailed in the *Site Investigation Report*. Within the *Site Investigation Report*, CEI will compare the results of the Site Investigation to remediation objectives calculated using the EPA's Soil Screening Level (SSL) model with default values or the "Generic Soil Screening Levels for Superfund."[1] Ground water results will be compared to the Class I and Class II ground water cleanup objectives listed in Part 620 of Title 35 of the Illinois Administrative Code (35 IAC Part 620).

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[1] For information regarding the SSL model and generic soil screening levels, CEI will refer to the three following EPA publications from 1996: *Soil Screening Guidance: User's Guide*; *Soil Screening Guidance: Technical Background Document*; and *Soil Screening Guidance: Response to Comments*.

If contaminant concentrations are detected above these remediation objectives, Fansteel may propose alternative site-specific remediation objectives. If significant soil contamination or a ground water contaminant plume is detected, an additional investigation may be performed to delineate the contaminant plumes. During an additional investigation, geological and/or hydrogeological testing may be performed to determine site-specific parameters that may be used to calculate site-specific remediation objectives using the Soil Screening Level model or other appropriate risk-based analysis models.

Upon completion of the proposed investigation(s), if the results indicate that near surface contamination at the Fansteel North Chicago facility is significantly impacting the adjacent Vacant Lot Site and remediation at the Fansteel North Chicago facility is appropriate, Fansteel will research viable remediation alternatives and prepare an Engineering Evaluation and Cost Assessment (EE/CA) Report, if necessary.

5.2 Technical Approach

The overall strategy for conducting the Site Investigation is based on a site-wide soil sampling with perimeter ground water monitoring. The Site Investigation activities will include emplacing 32 borings across the site to a depth of approximately 20 ft bgs. Selected samples from each boring will be submitted for analysis of total Pb, Cd and Ta, and VOCs. The proposed boring locations are shown in Figure Two in Attachment A.

Ten of the borings will be converted to ground water monitoring wells, each screened from approximately 10 to 20 ft bgs. The ground water monitoring wells will be developed and sampled for Pb, Cd and Ta, and VOCs. Measurements of the static water level and from a topographic survey of the monitoring well elevations will be used to calculate the approximate near surface ground water flow direction for the site. The proposed monitoring well locations are shown in Figure Two in Attachment A.

In order to assess the potential contribution of the Fansteel North Chicago facility's outfall discharges to Pettibone Creek, Fansteel proposes collecting sediment samples from Pettibone Creek at six locations. Samples will be collected from two depths at each location, 0 to 6 inches and 6 to 12 inches below the creek bottom. These twelve samples (two depths from six locations) will be analyzed for total TAL metals, total Ta, total CN and PCBs. The proposed creek sampling locations are shown in Figure Three in Attachment A.

The EJE railroad tracks run along the north border of the Vacant Lot Site and the Fansteel North Chicago facility. Immediately north of these tracks is a drainage ditch which appears to flow in a west direction and drains into Pettibone Creek just north of the Vacant Lot Site. a fenced area containing a bank of ComEd transformers where staining was observed. In order to evaluate whether possible PCB-containing surface water runoff from the transformer bank has flowed into the ditch and then to Pettibone Creek, two sediment samples will be collected from the drainage ditch at depths of 0 to 6 inches and 6-12 inches below the drainage ditch bottom. These two samples (two depths from one location) will be analyzed for PCBs. The proposed drainage ditch sampling location is shown in Figure Three in Attachment A.

5.3 Schedule

The Site Investigation will be initiated upon receiving EPA approval of this *Site Investigation Work Plan*. The schedule to complete the Site Investigation and associated *Site Investigation Report* is outlined in Table Two in Attachment A. As shown in this table, the *Site Investigation Report* should be completed within approximately 25 weeks. It should be noted, however, that this time estimate may change based on EPA comments.

5.4 Project Personnel

CEI's project management team involved in developing the *Site Investigation Work Plan* and conducting investigations at the facility includes the following individuals:

- Project Director — Edward E. Garske, CHMM
- Project Manager — Margaret M. Karolyi, EIT
- Project Engineer — Kenneth W. James, P.E.

Edward Garske, Project Director, will have final responsibility and authority for all work performed. Mr. Garske will assure the resources required to successfully complete the project are committed.

The Project Manager, Margaret Karolyi, is the key manager of project activities and is responsible for:

- Managing project operations and activities.

- Conducting technical review of each task being performed.
- Maintaining clear and effective communication with Fansteel's Project Manager.
- Working with Fansteel in project scoping and planning.
- Ensuring appropriate technical resources are utilized for each task.
- Ensuring field activities are conducted in accordance with program Health and Safety and QA/QC requirements.
- Ensuring proper technical consultation is provided.
- Maintaining overall project technical continuity.
- Controlling costs and schedule aspects of all project activities.

The Project Engineer, Kenneth James, will be responsible for maintaining the quality of all engineering activities associated with the project in addition to establishing detailed task specifications including schedules and estimates of labor and material costs.

Project Staff will include the following CEI personnel:

- Bruce A. Shabino, Staff Geologist
- Lisa M. Peradotti, Staff Geologist
- Phillip A. Hoeksema, Staff Geologist
- Samuel T. Bodine, Staff Scientist
- Jeffrey L. Voelker, Staff Scientist

The qualifications of the above listed CEI personnel are included in Attachment B.

6.0 QUALITY ASSURANCE PROJECT PLAN

CEI prepared a Quality Assurance Project Plan (QAPP) for the Site Investigation at the Fansteel North Chicago facility. The QAPP presents the organization, policies, QA/QC procedures, objectives and activities that will be utilized to ensure the data provided as a result of the Site Investigation at the facility are representative of site conditions.

Specific protocols for sampling, sample handling and storage, chain-of-custody, and laboratory and field analyses are described in the QAPP. The QA/QC procedures are structured in accordance with applicable technical standards, US EPA's requirements, regulations and guidance. This QAPP was prepared largely in accordance with a guidance manual entitled "Region 5 Model RCRA Quality Assurance Project Plan," May 1993.

Additionally, Great Lakes Analytical has provided a Quality Assurance Program that outlines the laboratory protocols and EPA Methods used for analyses, in addition to the QA/QC procedures employed by the laboratory. The Great Lakes Analytical Quality Assurance Program is included in Attachment D. CEI notes that the samples from the Site Investigation will be analyzed and reported in a manner consistent with a Level II data quality standard.

7.0 HEALTH AND SAFETY PLAN

It is the policy of CEI and Fansteel to provide a safe work environment for all their employees. No phase of operations or administration is of greater importance than injury and illness prevention. Safety takes precedence over expediency or shortcuts.

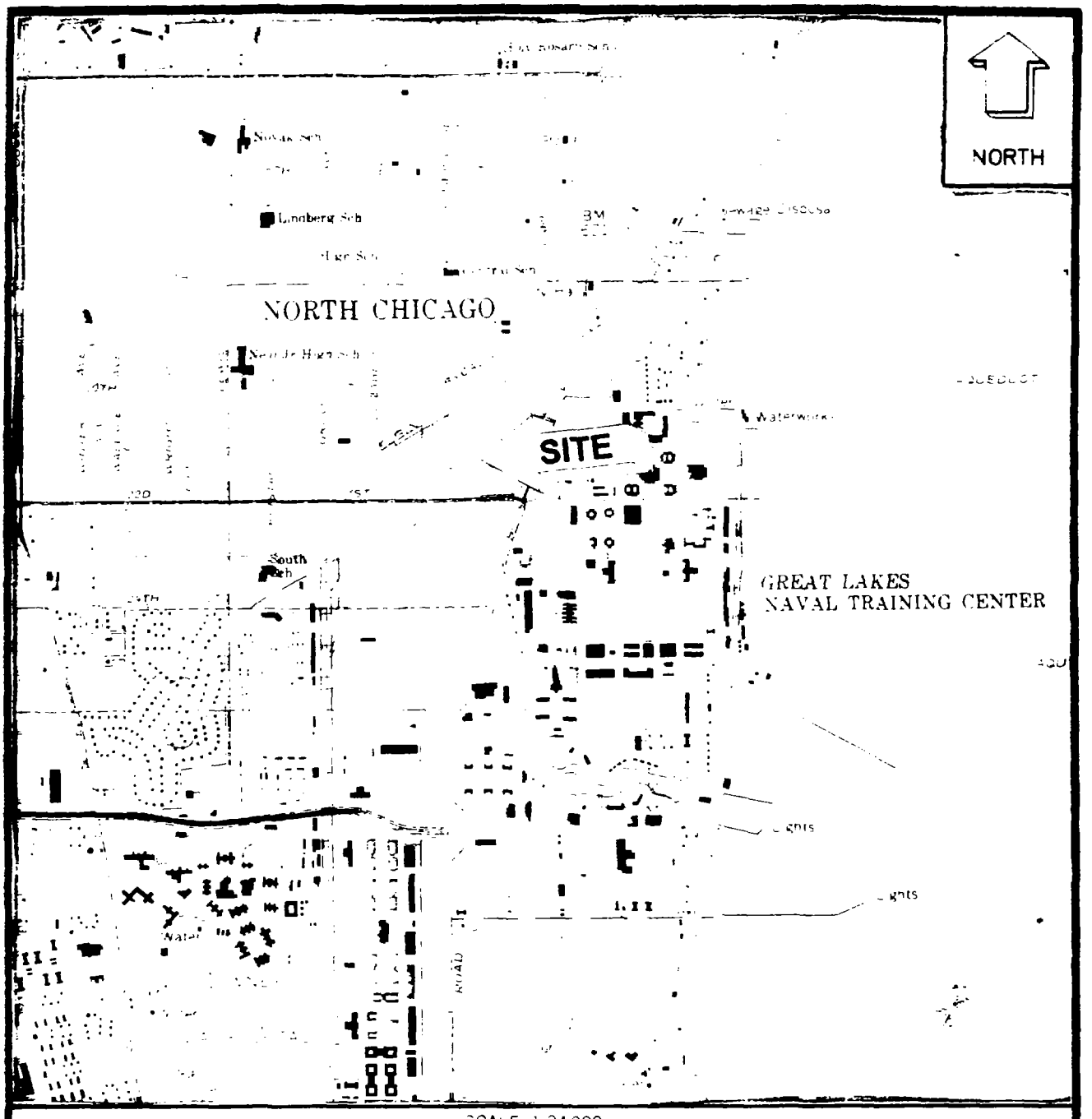
The Site Health and Safety Plan (SHSP) prepared for the Site Investigation at the Fansteel North Chicago facility prescribes the procedures that must be followed by all site personnel while on the project Site. Operational changes which could affect the health or safety of personnel, the community, or the environment will not be made without prior approval of Fansteel, the CEI Project Manager and CEI health and safety personnel.

The provisions of this plan are mandatory to all CEI personnel and subcontractors assigned to the project. CEI requires all visitors to any of the work sites to abide by these procedures. Work conditions can change as operations progress. The Health and Safety Manager will provide written addenda to this SHSP when changes warrant. No changes to the plans will be implemented without prior approval of the Health and Safety Manager or his/her authorized representative.

The Site Health and Safety Plan is included in Attachment E.

GABLESON
ENVIRONMENTAL INC

ATTACHMENT A
Figures and Tables



SCALE 1:24000

MILE

FEET

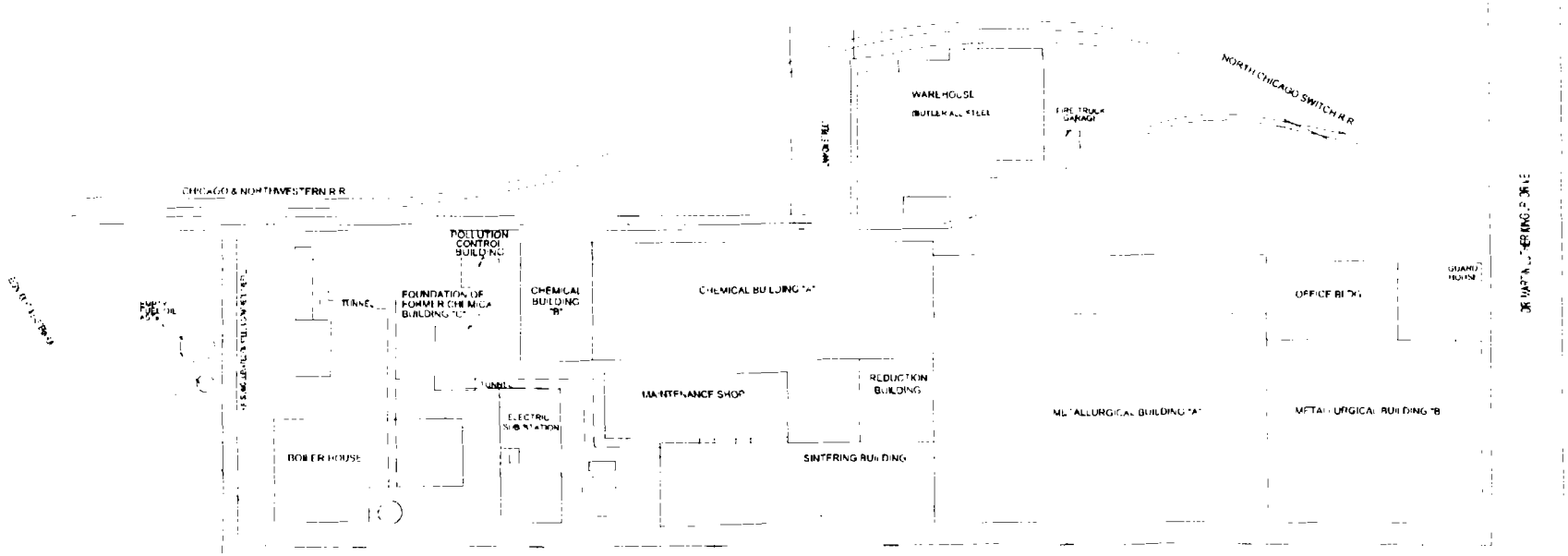
KILOMETER

CONTOUR INTERVAL 5 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929
DEPTH CURVES AND SOUNDINGS IN FEET—DATUM IS LOW WATER 578.5 FEET

CARLSON ENVIRONMENTAL, Inc.
312 West Randolph Street
Chicago, Illinois 60606
(312) 346-2140

FIGURE ONE
SITE LOCATION

Developed from U.S.G.S. 7.5 Minute
Topographic Quadrangle Map referenced in Text



LEGEND:

PROPOSED SOIL BORING LOCATION

PROPOSED MONITORING WELL LOCATION

SCALE:

0 50 100 200'

FIGURE TWO

PROPOSED SAMPLING LOCATIONS
FANSTEEL, INC.
One Tantalum Place
North Chicago, Illinois

CARLSON ENVIRONMENTAL, INC.
312 W. RANDOLPH STREET
CHICAGO, ILLINOIS
(312) 346-2140

PROJ. NO.:
DWG. NAME:
DATE:
SCALE: None

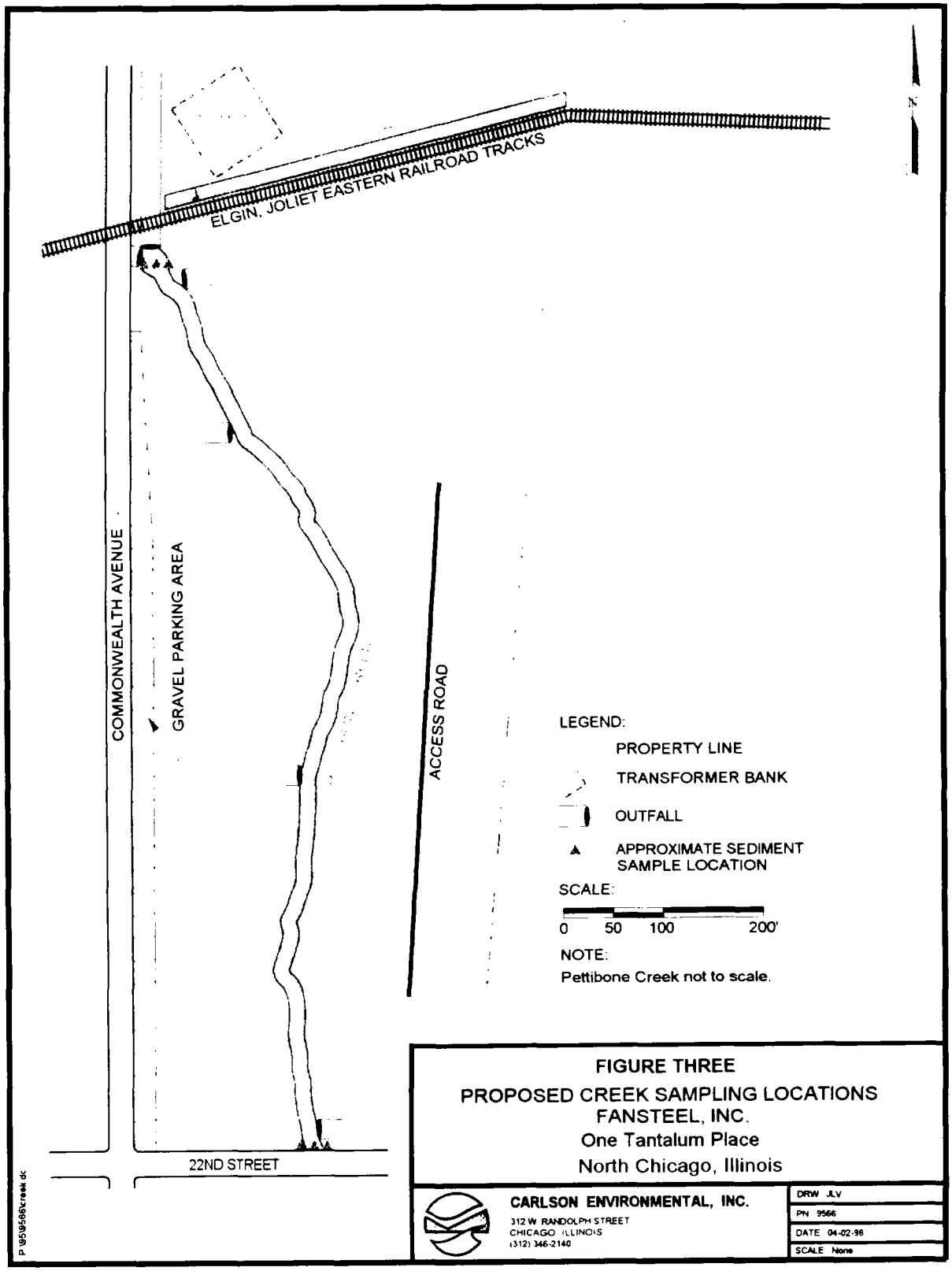


FIGURE THREE

PROPOSED CREEK SAMPLING LOCATIONS
FANSTEEL, INC.
One Tantalum Place
North Chicago, Illinois

CARLSON ENVIRONMENTAL, INC.
312 W. RANDOLPH STREET
CHICAGO, ILLINOIS
(312) 346-2140

DRW	JLV
PN	9566
DATE	04-02-98
SCALE	None

P:\9566\creek dc

TABLE ONE: Site Investigation Sampling Summary

Fansteel, Inc.
One Tantalum Place
North Chicago, Illinois

PARAMETER:	VOCs	Pb, Cd, & Ta	23 TAL Metals & Ta [2]	Total CN	PCBs	SAMPLE COLLECTION POINTS
EPA SW-846 METHOD:	5035/8260 [1]	3050/6010 [3]	3050/6010 [3]	9012	8082	
	MINIMUM NUMBER OF SAMPLES					
Soil	64	32	0	0	0	32 borings
Ground Water	10	10	0	0	0	10 wells
Creek Sediment	0	0	12	12	12	6 locations
Ditch Sediment	0	0	0	0	2	1 location

Notes:

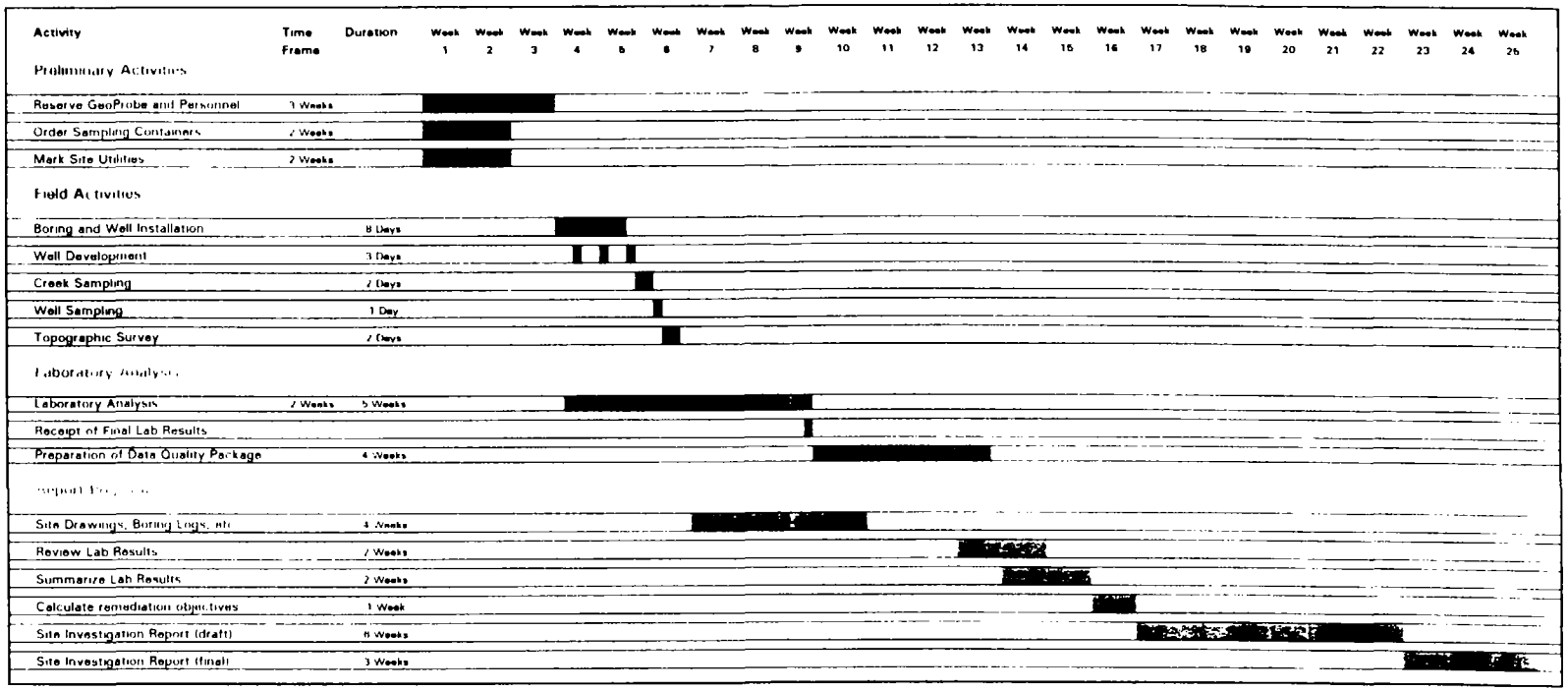
[1] Ground water samples analyzed for VOCs will be prepared using EPA SW-846 Method 5030

[2] 23 Target Analyte List metals include: Al, Sb, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Hg, Ni, K, Se, Ag, Na, Tl, V, and Zn

[3] All metals will be analyzed using EPA SW-846 Method 6010, except: As by 7060, Pb by 7421, Hg by 7471, and Se by 7740

TABLE TWO: Site Investigation - Estimated Schedule of Tasks

Fansteel, Inc.
One Tantalum Place
North Chicago, Illinois



ENVIRONMENTAL INC.

ATTACHMENT B
CEI Statement of Qualifications

CARLSON ENVIRONMENTAL, INC.

Corporate Office:
[redacted] West Randolph Street
Suite 300
Chicago, Illinois 60606
phone: (312) 346-2140
fax: (312) 346-6956

Satellite Office:
625 South Second Street
Springfield, Illinois 62704
phone: (217) 522-4985
fax: (217) 544-8814

Services & Experience

CARLSON ENVIRONMENTAL, INC.

CARLSON ENVIRONMENTAL, INC.

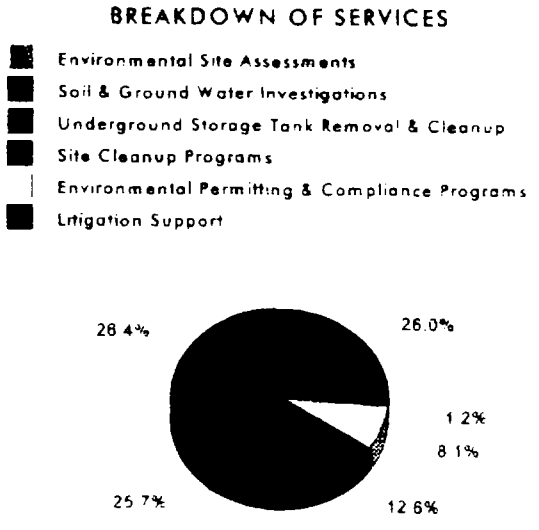
Section 1

Corporate Overview

CARLSON ENVIRONMENTAL, INC.

company background

Carlson Environmental, Inc. (CEI) was founded in 1988 by Dr. Richard J. Carlson, who had previously served as Director of the Illinois Environmental Protection Agency from 1981 through 1988. Dr. Carlson continues to oversee all aspects of the firm's engineering and consulting practice. CEI has evolved into a full service engineering and consulting firm. CEI maintains its principal office on the northwestern edge of Chicago's Loop, and a satellite office near the State Capitol Building in Springfield, Illinois.



CEI offers a broad range of consulting and engineering services designed to assist clients in managing environmental liability.

integrated services

CEI's ability to integrate our services allows us to address virtually any environmental problem facing a client. From simple site assessments to complex soil and ground water remediation systems, CEI provides total project management/"one stop shopping" for all projects in each of our service areas.

client partnerships

Long term client relationships form the foundation of CEI's corporate philosophy. CEI believes in building true partnerships with clients in order to more effectively manage the environmental challenges facing companies today. With a specialized knowledge of the environmental and regulatory community, CEI works to create and implement economical solutions that bring our clients a step closer to achieving their business goals.

regulatory relationships

The ability to work effectively with state and Federal regulatory agencies is crucial to the development of successful compliance programs. CEI's experience with the related bureaucracies and their rules and regulations is extensive and well-rounded. CEI acts as a liaison between clients and the pertinent agencies, allowing us to tailor solutions that are advantageous to all parties.

benefits to clients

CEI offers clients a full array of services, from management consulting to engineering design and construction management. Our staff is large enough to provide depth of experience and expertise; yet, small enough to ensure that clients receive the full attention of the firm's principals and staff. Since its founding in 1988, there has been very little turnover in CEI's technical staff. Through CEI's combination of compact size, staff stability and varied project experience, our consulting services have come to be characterized by: responsiveness, attention to client goals, and successful problem solving.

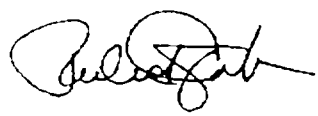
"As a firm that has succeeded because of long term client relationships and referral business, we believe in, and are committed to four basic tenets of client service. We at CEI:

Show up on time;

Follow through on our promises ;

Finish what we start;

Say please and thank you."



CARLSON ENVIRONMENTAL, INC.

about our founder...

Dr. Richard J. Carlson, President and Founder of CEI, oversees all aspects of the firm's engineering and consulting practice. With over twenty years of executive experience in government and the consulting industry, Dr. Carlson has developed a unique ability to create cost effective solutions to the problems of corporate environmental compliance.

Prior to founding CEI, Dr. Carlson served as the Director of the Illinois Environmental Protection Agency from 1981 to 1988. As the State's top environmental regulator, Dr. Carlson guided the IEPA through the development of the Illinois Superfund program, passage of the Illinois Ground Water Protection and Solid Waste Management Acts, and the implementation of the Resource Conservation and Recovery Act.

Through participation in the National Governor's Association and various committees of the United States Environmental Protection Agency (USEPA), Dr. Carlson has developed a broad knowledge of regulatory agency activities throughout the country. Prior to his position as IEPA Director, Dr. Carlson served as Special Assistant to Governor James R. Thompson for Environmental and Natural Resources.

CARLSON ENVIRONMENTAL, INC.

Environmental Assessments

Section 2

CARLSON ENVIRONMENTAL, INC.

environmental assessments

Parties involved in real estate transactions and business mergers or acquisitions should carefully evaluate property and facility conditions to determine if the property has been contaminated with hazardous substances and may require cleanup under Federal or State law. If environmental problems *do* exist, the cleanup cost could equal or exceed the value of the property. For real estate loans, lending institutions now typically require environmental assessments for commercial and industrial properties prior to financing in order to identify environmental liabilities that might affect the value of the collateral.

- CEI conducts Phase I site assessments to determine if past or present activities may have resulted in soil or ground water contamination, or if other environmental issues exist at the site such as asbestos or wetlands.

- CEI also conducts Phase II field testing, such as soil sampling and ground water monitoring, to determine the nature and extent of contamination and to estimate cleanup costs.

- If site remediation is required, CEI will design and implement cleanup programs.

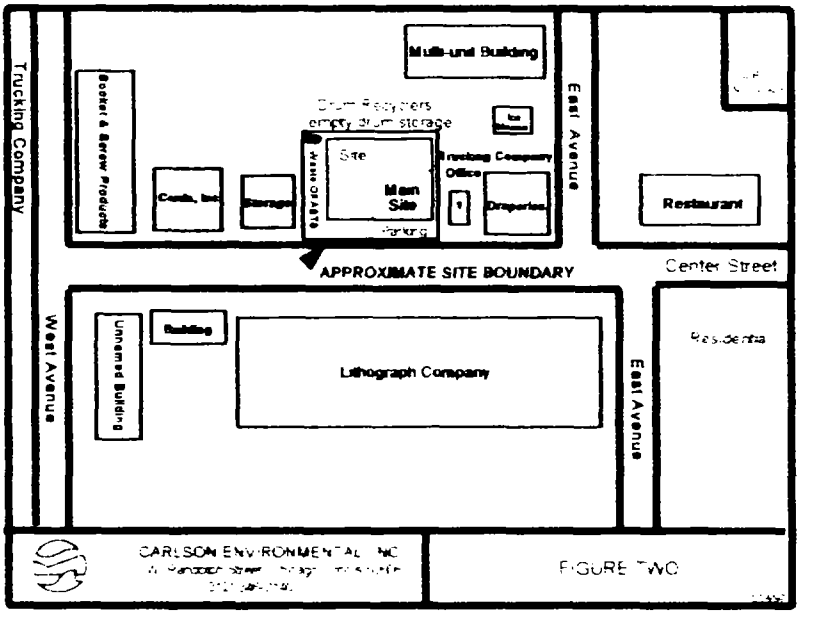
Conversion of a Manufacturing Facility to Residential Use

Chicago, Illinois
March 1995 to Present

On behalf of the developer, CEI conducted a Phase I Environmental Assessment for a site consisting of eleven buildings, two courtyards and two parking lots situated on 35 acres of land on Chicago's north side. The site had been the location of an electrical component manufacturing operation for over 60 years. In addition to the Phase I Environmental Assessment, CEI also worked on the terms of the purchase contract; provided oversight of investigation and remediation work conducted by the seller; and assisted in obtaining a Property Transfer Liability Insurance Policy to address environmental issues discovered during the development of the site. CEI will design and manage various cleanup activities agreed to be undertaken by the developer during the conversion of the site for residential use.

Multi-Site Assessment

As part of the due diligence required prior to forming one of the nation's largest real estate investment trusts, CEI performed Phase I Environmental Assessments on 32 industrial properties in the Chicago metropolitan area and Northern Indiana. CEI worked closely with the client and their attorneys to ensure that the environmental condition of each property was accurately represented to prospective shareholders.



Multiple Site Assessments, Chicago and Northern Indiana

Since that time, CEI has conducted over 50 Phase I/Phase II site investigations for properties as they are added to the Client's portfolio.

CARLSON ENVIRONMENTAL, INC.

American National Bank*
Bank One*
Bank of America*
CB Commercial
CenterPoint Properties, Inc.
Centrum Properties
Chicago Academy of Sciences
Chicago Lock Company
Citibank
Cole Taylor Bank*
Colliers, Bennett & Kahnweiler, Inc.
Comerica Bank*
Cozzi Iron & Metal
Dominick's Finer Foods
Knight Architects, Engineers & Planners
Korea First Bank
LaSalle Bank Lakeview
LaSalle National Bank*
LaSalle Northwest National Bank
Marquette National Bank*
Nationsbank*
The Levy Organization
Morgan Realty Partners
NBD Banks*
Old Kent Bank*
Paine/Wetzel Associates, Inc.
The Prime Group
Public Building Commission of Chicago

Representative Clients

Environmental Assessments

Eagle Foods Incorporated
Earl Scheib, Inc.
Fidelity Mutual Life Insurance Co.
First Midwest Bank*
First National Bank of Chicago
First National Bank of Illinois
Foster Bank
Glass Specialty Companies
Hannah Marine Corp.
Harris Bank & Trust
Illinois Housing Development Authority
Illinois International Port District
Johnstown America
Kendal Container Company
Pullman Bank
Reed Chatwood, Inc.
The RREEF Funds
Rubloff Development Group, Inc.
SIPI Metals
TCF Bank*
Tony Perry & Associates
United Parcel Service
Union National Bank of Elgin
Uno-Ven Products
Village of Oak Park
Village of Riverdale
Walsh Higgins & Co.
Wisconsin Tool & Stamping Co

*CEI is an approved environmental consultant at this financial institution

CARLSON ENVIRONMENTAL, INC.

Section 3

Soil and Ground Water Investigations

CARLSON ENVIRONMENTAL, INC.

soil and ground water investigations

Chemical releases from past and current facility operations can have significant impacts on soils and ground water systems. The migration of these impacts requires knowledge of applicable regulations as well as the practical "know how" to define the extent of contamination and to design cost effective cleanup remedies. CEI conducts soil and sediment sampling; implements ground water monitoring programs; designs and constructs remediation systems; and provides comprehensive project management services.

Sediment Sampling for a Dredging Program

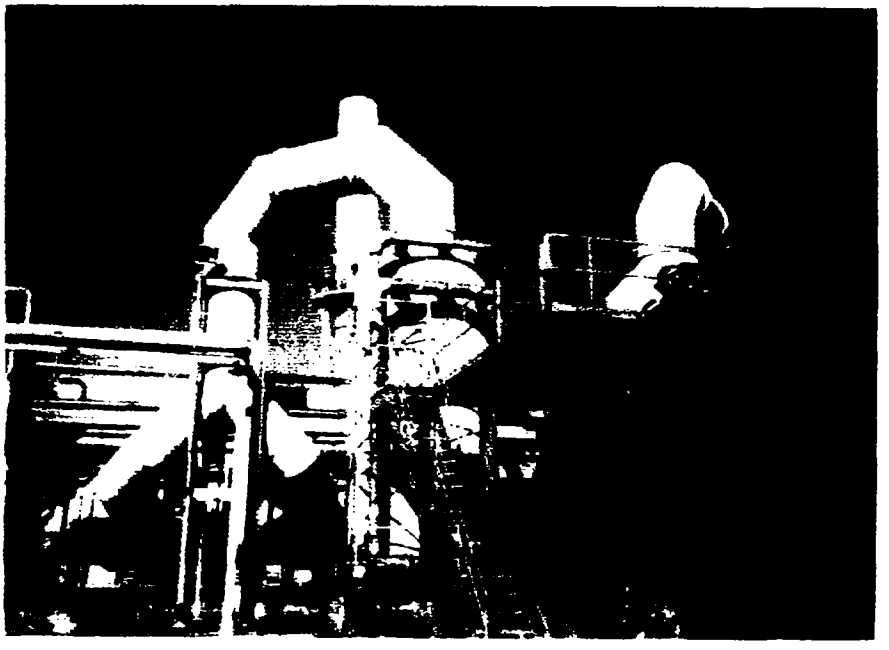
Since 1988, CEI has provided technical support for an ongoing program of dredging in Lake Calumet. This has included periodic sampling of the lake bed to support a State water quality certification under the Army Corps of Engineers permitting program. The sampling program typically includes sampling of the sediment layer and the underlying clay matrix and analyses for chemical and geotechnical parameters.

Lake Calumet - Chicago, Illinois

To conduct this type of sampling, CEI staff fabricated a unique hollow core hand sampling sediment device. Sampling work plans receive prior approval by IEPA and USEPA. Virtually all of the clay material dredged from Lake Calumet has been beneficially reused for landfill capping and related environmental construction in the area. Approximately 500,000 cubic yards have been used to cap an abandoned municipal landfill at the north end of Lake Calumet, which was subsequently developed into the Harborside International Golf Complex.

RCRA Facility Investigation (Phase I, II, III)
Chicago, Illinois

The subject site is located on a 27-acre pier extending 2,500 feet out into Lake Calumet on Chicago's southeast side. The site operates as an industrial waste treatment and handling facility under a RCRA Part B permit. Provisions of the permit require the operator to conduct a facility investigation to determine if "corrective action" is required to manage waste or product releases into the environment. Since January of 1995, CEI has been conducting a comprehensive investigation of soil and ground water conditions under IEPA-approved work plans. To date, over 500 soil samples have been collected and analyzed in a multi-phase investigation to define the nature and extent of contamination at the facility.



CARLSON ENVIRONMENTAL, INC.

Bank One
CenterPoint Properties, Inc.
Centrum Properties
Chicago Academy of Sciences
Clean Harbors
Coach & Car Equipment Corp.
Cole Taylor Bank
Colliers Bennett & Kahnweiler, Inc
Comerica Bank
Cozzi Iron & Metal
Dominick's Finer Foods
Harris Bank & Trust
Illinois Housing Development Authority
Illinois International Port District
Knight Architects, Engineers & Planners
LaSalle National Bank
The Levy Organization
Libbey-Owens-Ford
Loctite Corporation
Morgan Realty Partners
Production Tool
Public Building Commission of Chicago

Soil and Ground Water Investigations

Representative Clients

Eagle Foods Incorporated
Escast, Inc.
Fansteel, Inc.
Fidelity Mutual Life Insurance Co.
First National Bank of Chicago
Foster Bank
Freuhauf Trucking
General Motors Acceptance Corp
GLS Corporation
Glass Specialty Companies
Reed Chatwood, Inc.
The RREEF Funds
Robertson Ceco Corp.
Rubloff Development Group, Inc.
The Mirage
Soft Sheen Products, Inc.
United Parcel Service
Village of Riverdale
Walsh Higgins & Co.
Wesley-Jessen Corporation

CARLSON ENVIRONMENTAL, INC.

Section 4

Underground Storage Tank Removal & Cleanup

underground storage tanks

Federal and State regulations impose strict upgrading requirements on existing tank systems as well as design and operating standards for new tanks. Moreover, tanks no longer in use or leaking generally must be removed from the ground or abandoned in place. Contaminated soils or ground water must be cleaned up to acceptable levels.

- CEI conducts site investigations to determine if leaks have occurred; designs remediation programs for contaminated soil and/or ground water; oversees tank removals; and prepares State reimbursement applications.

- CEI also assists clients in obtaining "closure" letters from State regulatory agencies certifying that no additional cleanup is required at a site. This typically allows buyers and lenders to close transactions knowing that there is no substantial threat of further cleanup demands by the government.

UST Investigation, Removal and Closure
Chicago and Evanston, Illinois
1990 to 1997

In 1990, CEI investigated the presence of USTs at nine branch bank sites in and around Chicago. USTs were discovered at six of the locations. CEI provided oversight for the removal of tanks and contaminated soils at three sites. Formal closure letters have been obtained from the IEPA for each of these sites. The three remaining sites are scheduled for closure in 1997.

UST Investigations at 25 Sites
Skokie, Prospect Heights and Wheeling , Illinois
February 1996

At the request of the Client, CEI conducted regulatory database reviews and site inspections at 25 commercial property locations to determine if USTs were present, or if other site activities could result in waste or product releases to the environment. Initial site inspections were followed by soil sampling at selected sites to evaluate the nature and extent of suspected contamination.

CARLSON ENVIRONMENTAL, INC.

Underground Storage Tank Removal & Cleanup

Representative Clients

Aeropres, Inc.
Beatrice Company
Browning-Ferris Industries
Carol Stream Ice Arena
CB Commercial
CenterPoint Properties, Inc
Centrum Properties
Chicago Academy of Sciences
Chicago Lock Company
Citibank
City Insulation Company
Cole Taylor Bank
Colliers, Bennett & Kahnweiler, Inc
Comerica Bank
Corn Products
Cozzi Iron & Metal
Crescent Electric
Donahue's Truck Plaza
Downers Grove Ice Arena
Earl Scheib, Inc
Enterprise Rent-A-Car
Fansteel, Inc.
FCL/Stava
Fidelity Mutual Life Insurance
Fields Saab, Inc.
Finishing Plus, Inc.
First National Bank of Chicago
Foster Bank
Freuhauf Trucking
General Motors Acceptance Corp.
Glass Specialty Companies
Griffith Laboratories
Hallmark Mailing Services, Inc
Harris Bank & Trust
Hillcrest Healthcare Center, Inc.
HSA, Inc.
IEI Barge, Inc.
Illinois Federal Savings and Loan
Kendal Container Company
Korea First Bank
Lake Shore Athletic Club
LaSalle National Bank
Loctite Corporation
Louis A. Weiss Memorial Hospital
Marquette National Bank
Mancuso Cheese Company
Morgan Realty Partners
NBD Banks
Northern Builders/Rogers Leasing
Peacock Oil Company
Remin/Karta-A-Bag
RN Realty
The RREEF Funds
Soft Sheen Products
Tirapelli Ford, Inc
Tommy Armour Golf
Village of Oak Park
Village of Riverdale

CARLSON ENVIRONMENTAL, INC.

Section 5

Site Cleanup Programs

CARLSON ENVIRONMENTAL, INC.

site cleanup programs

Facilities regulated under various Federal and State programs (e.g. RCRA, CERCLA) may be required to cleanup contamination created by current or historical waste management practices. These cleanup programs typically involve soil and/or ground water remediation. Property owners, as well, may be compelled to address environmental issues to satisfy buyers or financial institutions.

- CEI has extensive experience in managing a wide variety of cleanups involving contaminated soil and ground water, as well as asbestos and lead paint abatement.

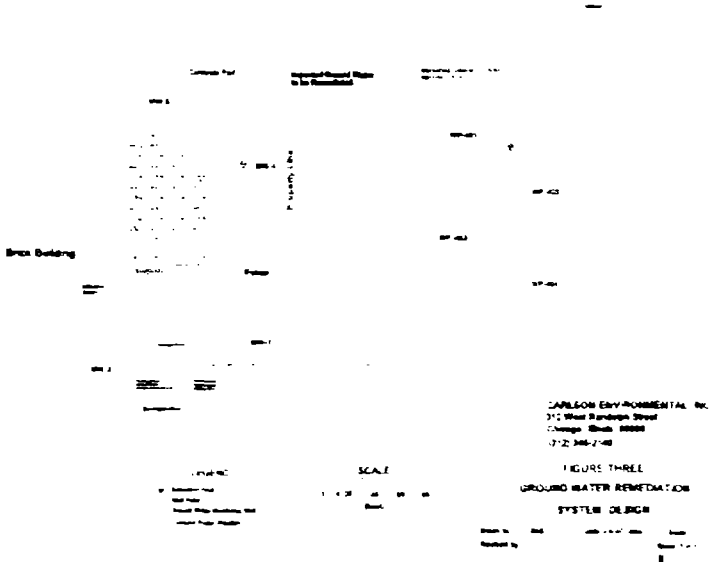
- CEI offers clients total project management capabilities from conceptual design to the procurement of closure letters from State regulatory agencies.

- CEI will define or confirm the extent of contamination through sampling programs and building inspections; prepare risk assessments; prepare bid specifications; and manage or coordinate remediation, abatement or decontamination services.

Soil Vapor Extraction/Ground Water Pump and Treat

Degreasing operations and drum storage of waste solvents over a period of years resulted in releases of chlorinated solvents into soil and ground water at this four-acre industrial site occupied by a 33,000 square foot building. A pilot test conducted by CEI in 1995 demonstrated that soil venting, in conjunction with ground water pumping and treatment methods will effectively remove solvents in the soil and ground water at the site. A work plan for implementing a full scale system has been submitted for approval to the IEPA, and construction is tentatively proposed for Summer 1997.

Mundelein, Illinois



Automobile Dealership
Chicago, Illinois

July 1994

In preparation for the sale and redevelopment of the site, a former automobile dealership, CEI removed two underground storage tanks; excavated and disposed of a small quantity of contaminated soils; removed all hydraulic lifts and associated piping; steam-cleaned sewers and catch basins underneath the site building; and removed all asbestos-containing building materials. The site was subsequently sold and redeveloped into a branch banking facility.

CARLSON ENVIRONMENTAL, INC.

Environmental Permitting & Compliance Programs

Section 6

environmental permitting & compliance programs

Companies that are developing or expanding manufacturing operations often require assistance in obtaining permits from regulatory agencies. In addition, changes in Federal and State laws frequently subject existing facilities to new permitting requirements.

CEI provides assistance to industry in meeting permit requirements for air, water, hazardous and solid waste. CEI staff develops the technical data necessary to complete permit applications; meets with regulatory agency staff to negotiate specific permit conditions; and designs control and compliance systems to satisfy permit requirements.

To address concerns about compliance enforcement, CEI will conduct liability assessments and facility and process evaluations to identify issues and develop compliance strategies.

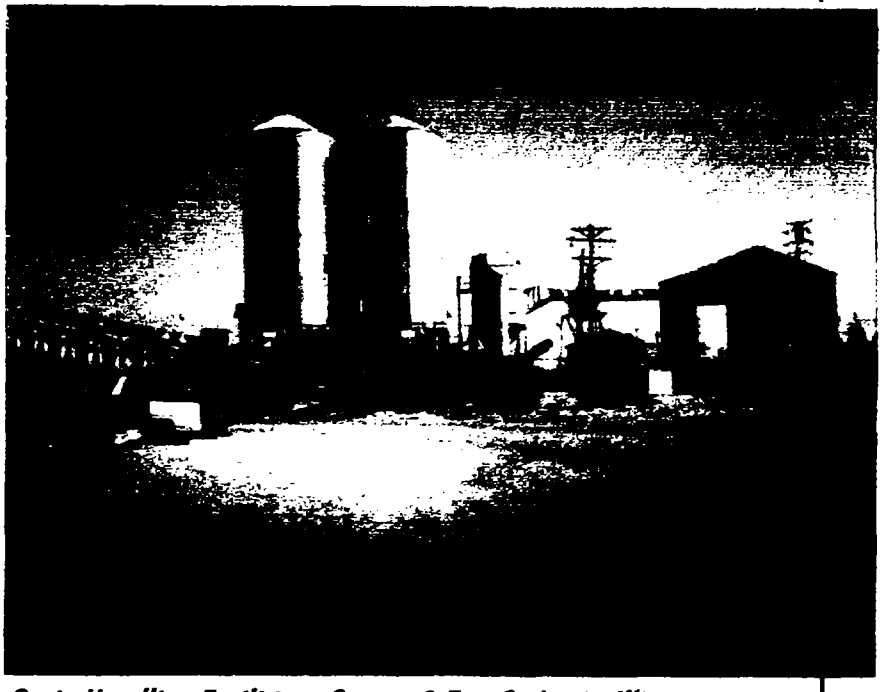
Air Pollution Modeling for Contingency Planning
Chicago, Illinois
1994 to 1995

The Client operates an industrial waste treatment, storage and handling facility. The facility's RCRA permit requires documentation of emergency response procedures, including the computer modeling of potential air pollution hazards that may result from a release, fire or explosion. CEI was retained to conduct the modeling utilized in evaluating the effects of these "worst case" scenarios.

CEI used this model to develop an assessment of the possible hazards that may result from a release, fire, or explosion. This required an estimation of the quantities and types of gases that could be generated. The modeling also assessed the effects of wind speed, atmospheric stability class, and atmospheric temperature on ambient air quality levels.

Compliance Program
June 1995 to February 1996

CEI performed an environmental audit and compliance review of two grain handling facilities located on or near the Mississippi River. The project included a walk through inspection and document review at the facilities. CEI formulated a detailed schedule of those actions needed to bring the facilities into compliance. This schedule included the preparation of 1994 and 1995 air emissions reports; a general housekeeping checklist; preparation and submission of a permit to the Illinois Department of Agriculture (IDOA) to handle and store dry bulk fertilizers; and preparation of Federally Enforceable State Operating Permits (FESOPs) to address air pollution.



Grain Handling Facilities - Sauget & East St. Louis, Illinois

CARLSON ENVIRONMENTAL, INC.

Section 7

Litigation Support

litigation support

Attorneys involved in environmental and toxic torts litigation often need scientific and technical support in developing effective litigation strategies. Such assistance involves a wide variety of scientific disciplines as well as a sophisticated knowledge of how regulatory agencies work.

- CEI staff can assist counsel in developing strategies to maximize the amount of information revealed during discovery; screen, review and organize documents.

- CEI will develop effective presentations of scientific and technical data, and provide "insider" understanding of the operation of Federal and State environmental agencies.

- CEI staff can also provide expert witness testimony in judicial and administrative hearings. Individual staff experience is outlined on the following pages.

Richard J. Carlson

Jiffy Lube International v The Southland Corporation (91 L 11220)

The Pulaski Venture v. Westinghouse Electric Corporation (91 C 3490)

Fansteel, Inc. v. Estronics et al (90 MR 355)

Mod-Tek, Inc. v. Lincoln Publishing (89 L 193)

Peter Engelland v. Clean Harbors, Inc. (94 L 11385)

Al Piemonte Dodge, Inc. v. Chrysler Motors Corporation (94 L 15469)

Alfred J. Paoletti v. Karr Cleaners, Inc. et. al. (94 L 0599)

Truck Components, Inc and Brillion Iron Works, Inc. v. Beatrice Company, Hunt-Wesson et al (94 C 3228)

In re: Energy Cooperative, Inc. (81 B 5811)

People of the State of Illinois v Arnold Enterprises (93 CH 1345)

Dayton Hudson v Cardinal Industries, et al.

Edward E. Garske

Prentiss Properties Acquisition Partners v. Theodore Ignasiak, et al (93-C-1368)

Chicago Transparent Products , Inc v American National Bank and Trust Company, as Trustee under Trust Nos 25628 and 25629 (90 CH 9069)

Nicholas J. Murlas Living Trust, et al v Mobil Oil Corp., et al (93 C 6956)

LaSalle National Bank v. American Hydraulics, Inc. and MNP Corporation (89 C 3532)

Kenneth W. James

Jiffy Lube International v. The Southland Corporation (91 L 11220)

Alfred J Paoletti v. Karr Cleaners, Inc. et. al. (94 L 0599)

People of the State of Illinois v. Challenger Manufacturing, Inc (96 CH3238)

Mankoff, Inc. v HSA, Inc (94 CH 1737)

Village of Rosemont v. Peacock Oil

CARLSON ENVIRONMENTAL, INC.

Thomas J. Swabowski
Bischoff Maurides & Swabowski, Ltd.
(312) 427-2600

Daniel Jarlenski
McGrath, North, Mullin & Kratz, P.C.
(402) 341-3070

Clifton A. Lake
McBride, Baker & Coles
(312) 715-5765

Jay A. Steinberg
Hopkins & Sutter
(312) 558-5186

Nicholas J. Parolisi, Jr.
Bullaro, Carton & Stone
(312) 831-1000

Joseph Wright
McBride, Baker & Coles
(312) 715-5700

Peter Zamis
Rathje, Woodward, Dyer & Burt
(630) 668-8500

Daniel J. Biederman
Hinshaw & Culbertson
(312) 704-3071

Eugene J. Frett
Sperling, Slater & Spitz
(312) 641-3200

Litigation Support

Representative Clients

CARLSON ENVIRONMENTAL, INC.

Insurance Coverage

Section 8

ACORD CERTIFICATE OF LIABILITY INSURANCE

CSR CG
CARLS-1

DATE (MM/DD/YY)
02/06/98

PRODUCER

Schwartz Brothers Insurance
135 S. LaSalle St., Suite 2035
Chicago IL 60603-4471

Joseph J. Schwartz, CPCU
Phone No. 312-630-0800 Fax No.

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW.

INSURED

Carlson Environmental, Inc.
Mr. Richard J. Carlson
312 West Randolph Street
Chicago IL 60606

COMPANIES AFFORDING COVERAGE

COMPANY A: Reliance Nat'l Indemnity Co.
COMPANY B: Reliance Ins Co of California
COMPANY C: American Motorists Insurance
COMPANY D: Reliance National Ins. Co.

COVERAGES

THIS IS TO CERTIFY THAT THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED. NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.

CO LTR	TYPE OF INSURANCE	POLICY NUMBER	POLICY EFFECTIVE DATE (MM/DD/YY)	POLICY EXPIRATION DATE (MM/DD/YY)	LIMITS	
	GENERAL LIABILITY				GENERAL AGGREGATE	$ 3,000,000
	X COMMERCIAL GENERAL LIABILITY	NGB251016803	12/05/97	12/05/98	PRODUCTS - COMP/OP AGG	$ 3,000,000
	X CLAIMS MADE OCCUR				PERSONAL & ADV INJURY	$ 1,000,000
	OWNER'S & CONTRACTOR'S PROT				EACH OCCURRENCE	$ 1,000,000
					FIRE DAMAGE (Any one fire)	$ 50,000
					MED EXP (Any one person)	$ 5,000
	AUTOMOBILE LIABILITY					
C	X ANY AUTO	F3R01603300	10/21/97	12/05/98	COMBINED SINGLE LIMIT	$ 1,000,000
	ALL OWNED AUTOS				BODILY INJURY (Per person)	$
	SCHEDULED AUTOS					
	HIRED AUTOS				BODILY INJURY (Per accident)	$
	NON-OWNED AUTOS					
					PROPERTY DAMAGE	$
	GARAGE LIABILITY				AUTO ONLY - EA ACCIDENT	$
	ANY AUTO	NOT PROVIDED			OTHER THAN AUTO ONLY	
					EACH ACCIDENT	$
					AGGREGATE	$
	EXCESS LIABILITY				EACH OCCURRENCE	$ 4,000,000
A	X UMBRELLA FORM	NUA1633541	12/05/97	12/05/98	AGGREGATE	$ 4,000,000
	OTHER THAN UMBRELLA FORM				Retention	$ 10,000
	WORKERS COMPENSATION AND EMPLOYERS' LIABILITY				X WC STATUTORY LIMITS / OTHER	
					EL EACH ACCIDENT	$ 1,000,000
D	THE PROPRIETOR/ PARTNERS/EXECUTIVE OFFICERS ARE INCL / EXCL	WAG013596600/WIC013596100	02/01/98	02/01/99	EL DISEASE - POLICY LIMIT	$ 1,000,000
					EL DISEASE - EA EMPLOYEE	$ 1,000,000
	OTHER					
B	Consultants Environmental Liab	NTF163449203 CLAIMS MADE COVERAGE	12/05/97	12/05/98	Per Claim / Aggregate	$5,000,000 / $5,000,000

DESCRIPTION OF OPERATIONS/LOCATIONS/VEHICLES/SPECIAL ITEMS

Consultants Environmental Liability Coverage Continued: $50,000 Self-Insured Retention. Claims Made Coverage. Retro Date 5/5/92

CERTIFICATE HOLDER

CARL-01

Carlson Environmental, Inc.
312 W. Randolph St., Ste. 300
Chicago IL 60606

CANCELLATION

SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, THE ISSUING COMPANY WILL MAIL 30 DAYS WRITTEN NOTICE TO THE CERTIFICATE HOLDER NAMED TO THE LEFT, BUT FAILURE TO MAIL SUCH NOTICE SHALL IMPOSE NO OBLIGATION OR LIABILITY OF ANY KIND UPON THE COMPANY, ITS AGENTS OR REPRESENTATIVES.

AUTHORIZED REPRESENTATIVE

Joseph J. Schwartz, CPCU

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CARLSON ENVIRONMENTAL, INC.

Management Profiles

Section 9

CARLSON ENVIRONMENTAL, INC.

Richard J. Carlson

President

- Represents clients in negotiating permits, compliance orders and consent decrees with Federal and State regulatory agencies.
- Manages environmental compliance audits and assists with the development of compliance management systems.
- Manages environmental assessments of a wide variety of commercial and industrial facilities for real estate transactions, mergers, and acquisitions.
- Provides expert testimony in support of various environmental litigation matters on behalf of clients

education

Doctor of Philosophy, Public Administration, University of Illinois

Master of Science, Communications, University of Illinois

Bachelor of Science, Communications, University of Illinois

selected professional activities

- Co-chair, Environmental Control Committee, Chicagoland Chamber of Commerce, 1988-1993.
- Staff Chair, Task Force on Global Climate Change, National Governors' Association, 1989-1990.
- Director, Illinois Asbestos Abatement Authority, 1988.
- Commissioner, Ohio River Valley Water Sanitation Commission, 1981-1988.
- Member, Water Quality Board, International Joint Commission, 1985-1988.
- Chair, Great Lakes Environmental Administrators, 1987-1988.

CARLSON ENVIRONMENTAL, INC.

Edward E. Garske

Vice President of Operations

- Manages all field operations.
- Directs business management programs and related staff.
- Supervises all project-related activities and project management

Project Manager

- Supervises underground storage tank removals, including the remediation of contaminated soils and ground water.
- Has conducted over 600 environmental site assessments.
- Provides oversight for a wide range of remedial action projects.

Has managed projects involving building inspections to identify and sample asbestos-containing building materials (ACBM), quantify ACBM, prepare bid documents, assist in contractor selection and oversee project management.

education

Bachelor of Science, Water Chemistry, University of Wisconsin

registrations / certifications

40-Hour OSHA 29CFR1910.120 HAZWOPER

AHERA Asbestos Building Inspector & IDPH Licensed

Certified Hazardous Materials Manager (CHMM) - Master Level

CPR and First Aid Training

CARLSON ENVIRONMENTAL, INC.

Kenneth W. James

Director of Engineering

Oversees all engineering operations, including underground storage tank investigations, removals, and remediation measures.

Project Manager/Engineer

- Manages underground storage tank investigations, tank removals and remediation of petroleum contaminated soils and ground water.
- Manages leaking underground storage tank (LUST) Site Classifications and prepares associated Illinois Environmental Protection Agency (IEPA) documentation.
- Designs and implements soil sampling and ground water monitoring programs.
- Manages the preparation of documentation required by the IEPA for the reimbursement of funds spent to remediate LUST sites.
- Provides professional engineering oversight for TSCA decontamination activities, RCRA Remedial Facility Investigations and RCRA closures.
- Prepares operating permits for the Clean Air Act Permit Program.

education

Master of Business Administration, The University of Chicago

Bachelor of Science, Chemical Engineering, Illinois Institute of Technology

registrations / certifications

Registered Professional Engineer, Illinois, Indiana, Ohio and Wisconsin

40-Hour OSHA 29CFR1910.120 HAZWOPER

Asbestos Contractor Supervisor (OSHA Competent Person) & IDPH Licensed

CPR and First Aid Training

CARLSON ENVIRONMENTAL, INC.

Valerie A. Baxa

Manager of Business Development/ Project Manager

- Directs all business development activities.
- Creates and implements client management programs.
- Manages asbestos abatement projects and RCRA closures and corrective actions.
- Has conducted over 200 environmental assessments for real estate transactions.
- Manages the preparation of environmental permit applications.
- Performs Phase II Environmental Assessment soil and ground water sampling activities.

education

Master of Environmental Management, Illinois Institute of Technology

Bachelor of Science, Loyola University of Chicago

registrations/certifications

Certified Hazardous Materials Manager (CHMM)

40-Hour OSHA 29CFR1910.120 HAZWOPER

8-Hour OSHA 29CFR1910.120(E) Site Supervisor

AHERA Asbestos Building Inspector & IDPH Licensed

CPR and First Aid Training

CARLSON ENVIRONMENTAL, INC.

Margaret M. Karolyi

Manager of Field Investigations/Project Manager

- Designs and supervises soil and ground water investigations.
- Manages projects for sites participating in State or Federal programs including RCRA, leaking underground storage tanks (LUSTs) and voluntary cleanups.
- Conducts risk-based analyses to determine remediation strategies and develop site-specific cleanup objectives (e.g. TACO and RBCA).
- Provides technical assistance to the design and implementation of remediation systems and corrective action activities.
- Prepares permit applications for waste water and storm water discharges and air pollution control applications.

education

Master of Science, Environmental Engineering, Illinois Institute of Technology

Bachelor of Science, Chemical Engineering, Michigan State University

registrations/certifications

Engineer In Training (EIT), Illinois

40-Hour OSHA 29CFR1910.120 HAZWOPER

8-Hour OSHA 29CFR1910.120(E) Site Supervisor

AHERA Asbestos Building Inspector & IDPH Licensed

CPR and First Aid Training

CARLSON ENVIRONMENTAL, INC.

Bruce A. Shabino

Manager of Remedial Actions/Project Manager

- Manages, designs and implements remediation strategies for a variety of projects.
- Oversees soil and ground water sampling and monitoring programs.
- Performs site classifications for leaking underground storage tank (LUST) sites and prepares associated IEPA documentation.
- Conducts hydrogeological investigations
- Manages underground storage tank (UST) removals and remediation.
- Conducts Phase II investigations.

education

Master of Science, Geology, University of Illinois-Chicago

Bachelor of Science, Environmental Health Science, Illinois State University

registrations/certifications

40-Hour OSHA 29CFR1910.120 HAZWOPER

8-Hour OSHA 29CFR1910.120(E) Site Supervisor

AHERA Asbestos Building Inspector & IDPH Licensed

Asbestos Contractor Supervisor (OSHA Competent Person) & IDPH Licensed

Licensed Air Sampling Professional

CPR and First Aid Training

CARLSON ENVIRONMENTAL, INC.

Lisa M. Peradotti

Project Manager

- Provides oversight for Phase I Environmental Assessments.
- Performs Phase II soil and ground water investigations.
- Performs site classifications for leaking underground storage tank (LUST) sites and prepares associated IEPA documentation.
- Conducts hydrogeological investigations and extent of contamination studies.
- Manages underground storage tank (UST) removals and remediation.

education

Master of Environmental Management, Illinois Institute of Technology*

Bachelor of Science, Geology, Northern Illinois University

registrations/certifications

Certified Professional Geologist

40-Hour OSHA 29CFR1910.120 HAZWOPER

8-Hour OSHA 29CFR1910.120(E) Site Supervisor

AHERA Asbestos Building Inspector

CPR and First Aid Training

*In Progress

CARLSON ENVIRONMENTAL, INC.

Elizabeth A. Seltzer

Site Assessment Manager/Project Manager

- Oversees the Phase I Environmental Assessment program
- Coordinates technical and historical information for Phase I reports.
- Conducts Phase I Environmental Assessments and building inspections for asbestos-containing building materials.
- Manages the preparation of environmental permit applications.
- Performs Phase II Environmental Assessment soil and ground water sampling activities.

education

Bachelor of Science, Environmental Biology, Eastern Illinois University

registrations/certifications

40-Hour OSHA 29CFR1910.120 HAZWOPER

8-Hour OSHA 29CFR1910.120(E) Site Supervisor

AHERA Asbestos Building Inspector & IDPH Licensed

CPR and First Aid Training

CARLSON ENVIRONMENTAL, INC.

Samuel T. Bodine

Project Manager

- Conducts Phase I Environmental Assessments and building inspections for asbestos-containing building materials.
- Performs Phase II Environmental Assessment soil and ground water sampling activities.
- Provides oversight for UST removals and preparesassociated IEPA documentation.
- Prepares permit applications for waste water and storm water discharges and air pollution control applications.
- Designs field investigation workplans and completes documentation and reports for clients or submission to regulatory agencies.
- Negotiates sites through the IEPA Site Remediation Program.
- Acting Health and Safety Coordinator and Equipment Manager.

education

Bachelor of Arts, Environmental Studies, Lake Forest College

registrations/certifications

40-Hour OSHA 29CFR1910.120 HAZWOPER

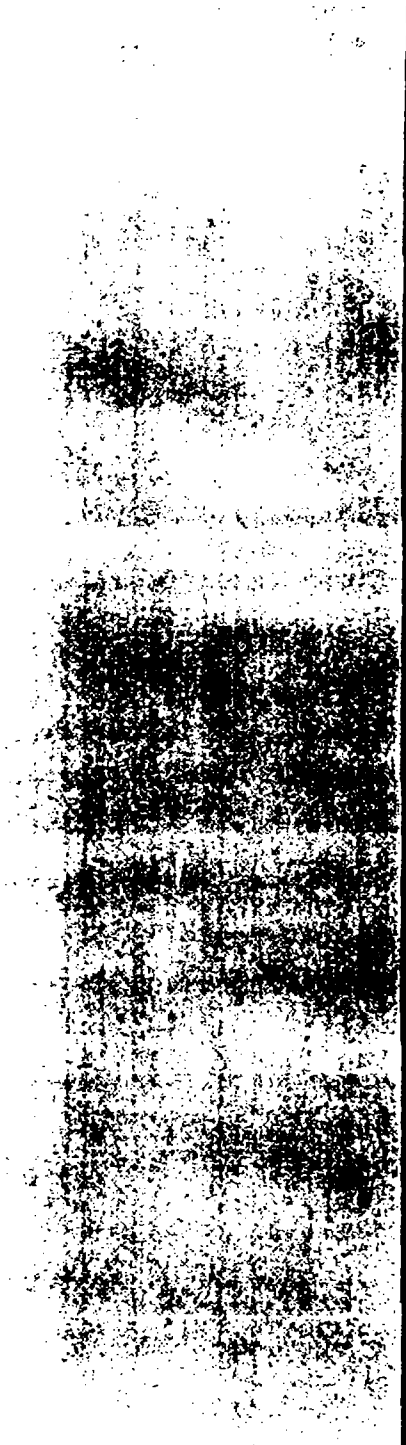
8-Hour OSHA 29CFR1910.120(E) Site Supervisor

AHERA Asbestos Building Inspector & IDPH Licensed

Asbestos Contractor Supervisor (OSHA Competent Person) & IDPH Licensed

Accredited Site Assessor by the State of Wisconsin

CPR and First Aid Training



CARLSON ENVIRONMENTAL, INC.

CEI is capable of assisting you with all of your environmental consulting and engineering needs. If we can be of service to you, or you would like more information about our firm, please do not hesitate to contact us at our corporate office.

312 West Randolph Street

Suite 300

Chicago, Illinois 60606

TELEPHONE: (312) 346-2140

FAX: (312) 346-6956

ENVIRONMENTAL, INC.

ATTACHMENT C
CEI Quality Assurance Project Plan

QUALITY ASSURANCE PROJECT PLAN

Fansteel, Inc.
Number One Tantalum Place
North Chicago, Illinois

Prepared by
CARLSON ENVIRONMENTAL, INC.
312 West Randolph Street
Suite 300
Chicago, IL 60606
(312) 346-2140

Project No. 9566A
April 1998

TABLE OF CONTENTS

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1.0 INTRODUCTION

This Quality Assurance Project Plan (QAPP) was prepared for Fansteel, Inc. (Fansteel) at Number One Tantalum Place in North Chicago, Illinois. The QAPP presents the organization, policies, QA/QC procedures, objectives and activities that will be utilized to ensure the data provided as a result of a Site Investigation at the property are representative of site conditions. The QAPP is designed to meet the data quality goals of the Site Investigation.

Specific protocols for sampling, sample handling and storage, chain-of-custody procedures, and laboratory and field analyses are described in the QAPP. The QA/QC procedures are structured in accordance with applicable technical standards, requirements, regulations and guidance.

This QAPP is Attachment C to the *Site Investigation Work Plan* for the Fansteel facility at Number One Tantalum Place in North Chicago, Illinois (also referred to as the Fansteel North Chicago facility).

2.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

The following sections define the project team organization, personnel, duties and responsibilities. Carlson Environmental, Inc. (CEI) has been retained by Fansteel to manage the Site Investigation. The various quality assurance, field, laboratory and management responsibilities of key project personnel are defined below.

The following responsibilities have been assigned for the project:

- Project Director — Edward E. Garkse, CHMM (CEI)
- Project Manager — Margaret M. Karolyi, EIT (CEI)
- Project Engineer — Kenneth W. James, P.E. (CEI)
- Project Administrator — E. Jonathan Jackson, CHMM (Fansteel)
- Quality Assurance Officer — Edward E. Garske, CHMM (CEI)
- Off-Site Laboratory Operations — Great Lakes Analytical
- Site Health and Safety Manager — Valerie A. Baxa, CHMM (CEI)

Other CEI staff and subcontractor personnel will be utilized as needed. All CEI field personnel and subcontractors are medically monitored on an annual basis, and have completed OSHA 40 hour training and annual 8 hour refresher training, as required.

Resumes for CEI Project Personnel are included in Attachment B of the *Site Investigation Work Plan.*

2.1 Project Director

The Project Director will have overall responsibility for CEI's effort on the project. The Project Director will ensure the investigation proceeds in a time effective manner consistent with the goals of the Site Investigation. The Project Director will act as lead consultant, and in addition will conduct the following activities:

- Assist the Project Manager in project planning activities.
- Attend meetings between Fansteel and CEI.
- Interface with the Project Manager on progress in the areas of technical activities, budget, and schedule.
- Review key project documents, including this QAPP.

2.2 Project Manager

The Project Manager (PM) will be the prime point of contact with Fansteel and will have primary responsibility for technical, financial, and scheduling matters. If significant deviations from this plan are encountered during the course of the investigation, the PM will consult with Fansteel personnel and obtain their approval to proceed if changes are required. The PM will conduct the following activities:

- Assign duties to the project staff and orient the staff to the needs and requirements of the project.
- Supervise project team members.
- Control the project budget and schedule.

- Review subcontractor work and approve subcontractor invoices.
- Review all reports for technical accuracy and completeness prior to submission to the State.
- Establish a project record keeping system.
- Be responsible for the preparation and quality of interim and final reports.

2.3 Project Administrator

The Project Administrator is the principal Fansteel contact for the Site Investigation activities.

2.4 Quality Assurance Officer

The Quality Assurance Officer (QAO) will be responsible for ensuring that all Site Investigation activities adhere to the QA/QC guidelines defined in this QAPP. This adherence is critical in order to provide acceptable/representative data.

2.5 Field Staff

The geologist or other field staff will be responsible for conducting the following activities:

- Providing direction and supervision to the drilling contractor.
- Ensuring that appropriate field logs are maintained for project activities.
- Supervising the collection of all samples, and providing for their proper handling and shipping.
- Monitoring drilling and sampling operations to ensure that the drilling contractor and sampling team members adhere to the QA provisions of the plan.
- Reviewing and evaluating the analytical results.

2.6 Off-Site Laboratory Manager

The Laboratory Manager for Great Lakes Analytical is responsible for ensuring that laboratory personnel adhere to the laboratory's Quality Assurance Program (QAP), included as Attachment D to the *Site Investigation Work Plan*.

2.7 Site Health and Safety Officer

The field activities associated with this plan will be conducted in accordance with the requirements of the project Site Health and Safety Plan (SHSP), submitted under separate cover as Attachment E to the *Site Investigation Work Plan*. CEI staff assignment for the management of compliance is detailed in the SHSP.

2.8 Subcontractors

CEI will use the following subcontractor for drilling activities at the Site:

Paramount Environmental Services
2554 Samuelson Road
Portage, Indiana 46368
Phone: 800/303-8580

An alternative drilling subcontractor is:

Rock & Soil Drilling Corporation
1720 East Tyler Road
St. Charles, Illinois 60174
Phone: 800/232-7190

3.0 QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT DATA

The overall quality assurance (QA) objective for this project is to develop and implement procedures for field sampling, chain-of-custody, laboratory analysis, and reporting that will provide results which are legally defensible in a court of law. Specific procedures for sampling, chain-of-custody, laboratory instrument calibration, laboratory analysis, reporting of data, internal quality control, audits, preventive maintenance of field equipment, and corrective action are described in other sections of this QAPP.

Data Quality Objectives (DQOs) are qualitative and quantitative statements that specify the quality of the data required to support decisions made during the Site Investigation activities. DQOs are based on the end uses of the data to be collected. Different data uses may require different levels of data quality. Fansteel proposes using a Level II Data Quality for analyses conducted as part of the proposed Site Investigation. These analyses require full documentation of SW 846 analytical methods, sample preparation steps, data packages and data validation procedures necessary to provide defensible data. Quality Control (QC) must be sufficient to define the precision and accuracy of these procedures at every step.

3.1 Precision

Precision is the degree to which two or more measurements are in agreement. Field precision is evaluated through the collection and analysis of duplicate samples at a rate of 1 duplicate per 10 analytical samples.

The precision of analytical project measurements is assessed through the calculation of relative percent difference (RPD) of duplicates or relative percent standard deviations (RSD) of replicates. The equations used to calculate precision are provided in Section 8.6.3 of the Great Lakes Analytical QAP, included as Attachment D to the *Site Investigation Work Plan*. The precision will be evaluated and reported with the method reference number. Precision measurements will be conducted using appropriate instrumentation, high purity materials, trained laboratory personnel, internal quality controls and consistent scientific practice.

3.2 Accuracy

Accuracy is a measure of the relationship of the observed value to an accepted reference value. Field accuracy is assessed through the use of field blanks and adherence to sample handling, preservation and holding times.

Laboratory accuracy is assessed through the analysis of matrix spikes or standard reference materials and the determination of percent recoveries. The laboratory's procedure for determining accuracy is outlined in Section 8.6.2 of the Great Lakes Analytical QAP, included as Attachment D to the *Site Investigation Work Plan*.

3.3 Completeness

Completeness is a measure of the amount of valid data obtained from a measurement system, compared to the amount expected to be obtained given normal conditions. The data base will be evaluated on a routine basis to assess actual versus expected data, and will be developed to the point where the data base is capable of supporting statistical analysis for interpretational purposes.

The percent completeness can be calculated as follows:

$$\text{Completeness} = \frac{\text{(number of valid measurements)}}{\text{(number of measurements planned)}} \times 100$$

3.4 Representativeness

Representativeness is the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition or an environmental condition.

Representativeness in the field depends upon the adequacy of the sampling program design and will be satisfied by ensuring that the field sampling plan is followed and appropriate sampling techniques are used.

Representativeness in the laboratory is ensured by using the appropriate analytical procedures, meeting holding times, and analyzing and assessing field duplicate samples. The sampling locations were selected using a grid sampling system in order to provide data representative of facility conditions.

3.5 Comparability

Comparability is the expression of confidence with which data sets can be compared with each other. Analytical data are comparable when similar sampling and analytical methods are used, with similar quality assurance objectives. Comparability will be achieved in part by citing standardized sampling and analysis methods, and utilizing standard data formats. Deviations from standard operating procedures will be noted and data will be qualified for comparative purposes.

If identified, inconsistencies within data sets or deviations from expected results will be evaluated to determine if the inconsistency is the result of sampling collection or handling procedures, analytical procedures, or unpredicted natural fluctuations. The evaluation will include a review of documentation of sample collection activities, laboratory chain-of-custody records, chromatograms and analytical procedures. If inconsistency is found to be due to sample mishandling, the sample will be duplicated for analysis if feasible.

4.0 SAMPLING PROCEDURES

4.1 Introduction

The objective of the procedures outlined in this section is to obtain representative samples of the matrix to be tested. The procedures should eliminate the potential for contamination of the sample by external sources. This section will present the following information:

- Describe the Geoprobing and monitoring well installation;
- Describe soil, sediment and ground water sampling methods;
- Describe the sample numbering system, storage and shipment procedures; and
- Outline the procedures for documentation of field activities.

The rationale for the selection of borehole locations, monitoring well locations, sediment sample locations, and the number of soil and ground water samples collected during the Site Investigation, is discussed in Sections 4.2 and 4.3 of the *Site Investigation Work Plan.*

As described in the *Site Investigation Work Plan*, the following activities will be conducted during the investigation:

- 32 soil borings will be installed using a Geoprobe;
- Monitoring wells will be installed in ten of the soil borings;
- Sediment samples will be collected from six locations in Pettibone Creek and one location in the ditch north of Pettibone Creek;

- The soil borings will be continuously sampled and logged in order to provide an indication of the composition and quality of the unconsolidated materials at the site.

- Ground water samples will be collected from the ground water monitoring wells;

- Field tests and laboratory analyses will be conducted (on soil and ground water samples) to provide an indication of the horizontal and vertical extent of potential impacts at the site;

- The monitoring well locations will be surveyed in order to determine ground water flow direction;

- Duplicate samples will be collected to meet quality assurance/quality control objectives.

4.2 Soil Boring Installation and Sampling

Approximately 32 soil borings will be drilled using a Geoprobe® Macro Core Soil Sampling System. The approximate borehole locations are shown on Figure Two in the *Site Investigation Work Plan*. Soil samples will be collected on a continuous basis to an approximate completion depth of 20 feet below ground surface (ft bgs). Soil samples will be collected from each boring using a 48-inch stainless steel sampling tube lined with cellulose acetate butyrate (CAB) sampling sleeves.

All "down hole" equipment, including Geoprobe® rods and sampler assembly, well screening and well casing materials, will be steam-cleaned prior to beginning each boring. Water generated as a result will be contained in labeled 55-gallon drums pending disposal analysis. New Geoprobe® CAB sampling sleeves will be used for each sample interval.

The soil sampling procedure outlined below will be used at for each of the soil borings:

1. Record borehole location, the project number, the project name, the borehole identification number, personnel responsible for logging the borehole, drilling method and borehole diameter, dates and times of drilling, and drilling contractor name on each borehole log.

2. Drill to the start of the appropriate sampling depths and obtain soil samples with a split-spoon sampler.

The retrieved samples will be examined in the field. The samples will be screened for evidence of contamination, such as staining or elevated readings on an organic vapor detection field instrument (either a photoionization detector (PID) or a flame-ionization detector, (FID)). The field instrument provides qualitative information regarding potential contamination levels, which may assists in determining the extent of potential contamination at the site and provides information for health and safety monitoring purposes.

Sample collection procedures are as follows:

1. Upon cutting opening the CAB sample sleeve, the sample will be split into containers for possible future analysis. Laboratory-prepared, clean glass sample jars with teflon-lined lids will be used to contain each sample fraction. When collecting samples for possible volatile organic compounds (VOCs) analysis, the sample will be placed in laboratory-supplied jars containing the appropriate preservative. Sample containers will be placed in iced, secure storage until subsequent preparation for shipment.

2. A portion of the sample will be placed in a new, sealed plastic bag for headspace analysis. The sample collected in a sealable plastic bag will be allowed to equilibrate for at least ten minutes. If the ambient temperature is below 32°F, headspace development should be within a heated vehicle or building. The sample will be shaken and kneaded to release volatile compounds into the headspace of the bag. The probe of the PID or FID will then be inserted in the bag and the highest reading for the sample will be recorded on the borehole log.

3. The sample will be examined and all observations recorded on the borehole logs. The lithologic description will include information regarding soil type, grain size distribution, plasticity, color, moisture (expressed as dry, moist, wet or saturated), consistency, density, grain shape and lithology, and group symbol.

Additional information to be included on the borehole log forms includes the following:

- Difficulties encountered during drilling.
- Depth at which ground water is encountered, if applicable.

- PID or FID monitoring results.
- Depth/elevation of sampling interval.
- Depth/elevation of strata changes.
- Sample recovery.
- Total depth of completed boring.
- Depth of any grouting or sealing and the amount of cement and/or bentonite used.
- Identification numbers for samples and duplicates.

Equipment for the sampling program will include the following:

- A sufficient number of rods and CAB sleeves allow uninterrupted sampling.
- Geoprobe equipment.
- Distilled and potable water.
- Personal safety equipment.
- PID or FID.
- Laboratory-supplied sample containers.
- Sealable plastic baggies.
- 55-gallon drums.

4.3 Ground Water Monitoring Well Installation and Sampling

Ten soil borings will be converted into permanent monitoring wells. The approximate monitoring well locations are shown on Figure Two in the *Site Investigation Work Plan.*

All well screening and casing material will be steamed clean prior to installation. The 2-inch diameter wells will be set at a depth of 20 feet with the lower 10 feet consisting of continuous No. 10 PVC screening and the upper 10 feet consisting of solid schedule 40 PVC. Quartz sand will be placed around the screen to an elevation of 1 to 2 feet above the screen. A bentonite seal will then be placed above the quartz sand to provide an impermeable seal in the borehole. In order to secure the wells, a locking stick-up or flush-mounted well protector will be cemented around the top of each well. Bentonite chips will be used to fill the void between the bentonite seal and the bottom of the well protector.

All sampling equipment will either be steam-cleaned or washed with a laboratory grade detergent (Alconox), rinsed with tap water and final-rinsed with distilled water between consecutive samples.

Sample collection procedures are as follows:

1. Approximately 48 hours after installation, each ground water monitoring well will be developed using a stainless steel bailer or a ground water purge pump. The development will be considered complete when three borehole volumes have been removed. Development water will be contained in 55-gallon drums.

2. The static water level was measured and recorded to 0.01 feet with an electric water level indicator (Solinist model 101). These values will be used to determine the direction of near surface ground water flow across the site at the time of the sampling event.

3. Once the wells are developed, a sample from each well will be collected using a stainless steel bailer after a minimum of three well volumes have been removed. Laboratory-prepared, clean glass/plastic sample containers with teflon-lined lids and preservatives (where applicable) will be used to contain each sample.

4. The sample will be examined and all observations recorded on the sample logs. The description will include information regarding color, turbidity and the presence of sheens.

Sample containers will be placed in iced, secure storage until subsequent preparation for shipment.

Equipment for the sampling program will include the following:

- Ground water sampling pumps.
- Stainless steel bailers.
- Electric water level indicator.
- Distilled and potable water.
- Personal safety equipment.
- Rope.
- 40 mL glass vials with teflon-lined septa, amber glass bottles with teflon-lined lids, and plastic bottles.
- 55-gallon drums.

4.4 Sediment Sampling

Approximately fourteen sediment samples will be collected from seven sampling locations. The approximate sediment sampling locations are shown on Figure Three in the *Site Investigation Work Plan.* At each proposed sediment sample location, the sediment samples will be collected using a stainless steel trowel or AMS stainless steel hand auger. The sediment sample will be retrieved from two sample depths, 0 to 6 inches and 6 to 12 inches below the creek or ditch bottom.

All sampling equipment will be cleaned with an Alconox solution and rinsed with distilled water prior to use at each well. The individual collecting the samples will wear new vinyl gloves during the collection of each sample. Each sediment sample will be placed in an unpreserved sample jar.

Sample collection procedures are as follows:

1. Upon retrieval of the sample, the sample will be split into containers for possible laboratory analysis. Laboratory-prepared,clean glass sample jars with teflon-lined lids will be used to contain each sample fraction. Once filled, the sample containers will be placed in iced, secure storage until subsequent preparation for shipment.

2. The sample will be examined and all observations recorded on the field logs. The soil description will include information regarding soil type, grain size distribution, plasticity, color, moisture (expressed as dry, moist, wet or saturated), consistency, density, grain shape and lithology, and group symbol.

Additional information to be included on the borehole log forms includes the following:

- Difficulties encountered during sample retrieval.
- Sample interval depth.
- Depth of strata changes.
- Identification numbers for samples and duplicates.

Equipment for the sampling program will include the following:

- Stainless steel trowel and AMS hand auger system.
- Distilled water.

- Personal safety equipment.
- Laboratory-supplied sample containers.

4.5 QA/QC Sampling

To check the quality of data obtained from field sampling and analytical efforts, duplicate samples will be collected for analyses. The duplicate samples will be collected at a ratio of one duplicate for every ten samples targeted for initial laboratory analysis. The duplicate samples will be treated as separate samples for identification, logging and shipping. Analytical results on the duplicates will be filed with the appropriate field sample data.

Trip blanks will be prepared by the laboratory. Each day sampling activities are conducted, one trip blank sample will be placed in the cooler used to store and transport the samples. The trip blank sample will be analyzed for VOCs.

Field blank samples will be collected on a daily basis by running distilled water through or across the field equipment that will be used that day. For example, through the Geoprobe® CAB sleeve and sampler assembly (for soil sampling), the stainless steel bailer (for ground water sampling), or across the stainless steel trowel or hand auger (for sediment sampling). The field blank will be submitted for analysis of any laboratory analyses being performed on any samples collected during that day's field activities.

4.6 Sample Designation

An alpha-numeric system will be used to identify each sample, including duplicate, field and trip blank samples. The first portion of the identification will consist of the letter(s) "GP" for soil borings, "MW" for monitoring wells and "S" for sediment samples. These prefixes will be followed by a number which indicates the borehole or sediment sample location number or the monitoring well number. Each sample interval from a particular borehole will be labeled alphabetically. For example, the first sample collected from a depth of 0-2 ft bgs from borehole 12 would be designated GP12-A. The second sample, from 2-4 feet, would be designated GP12-B. Duplicate samples taken will designated in a manner similar to the corresponding soil, sediment or ground water sample designation to prevent the laboratory from identifying the sample as a duplicate sample.

Field blank samples will be assigned with the prefix "FB" and trip blank samples with the prefix "TB." The number corresponding to the Julian date will be follow the field or trip

blank prefix. For example FB-230 and TB-230 would correspond with the field and trip blank samples from August 18th.

4.7 Cuttings Disposal and Borehole Abandonment

Cuttings, development water and decontamination water will be contained in steel 55-gallon drums and placed in a location designated by Fansteel representatives until analytical results can be reviewed and appropriate disposal can be arranged, if necessary. Drums will be labeled with the source borehole or monitoring well number.

Borings will be abandoned immediately after sampling. The borings will be backfilled with bentonite chips. In areas that are paved or covered by buildings, a concrete or asphalt patch will be applied to the surface of the boring.

4.8 Sample Storage

All sample jars and bottles will have teflon-lined lids and will be provided by Great Lakes Analytical. Each sample will be placed in labeled sample jars or bottles, capped, and placed in sealed plastic baggies, and stored in an iced cooler at 4°C. Samples not shipped to the laboratory will be stored at Carlson Environmental, Inc., offices in a refrigerated space to maintain the temperature of the sample at 4°C. These samples will be maintained under standard chain-of-custody procedures.

4.9 Documentation

A hard-cover, bound field logbook will be used to record all daily activities performed at the site. Detailed entries will be made to allow situations to be reconstructed if necessary. The date, weather, time, site personnel, visitors and the purpose of the visit, will be recorded in the logbook. The logbook will be stored securely in the office when not in use. Borehole log sheets will be completed in the field for each borehole. The logs will detail all information regarding the sampling method, the identification of the borehole, and a description of each sample collected from the borehole. The PM will retain custody of these documents upon completion of the project.

Project sampling activities will be documented by keeping a written record of daily sampling activities and implementing a series of interrelated chain-of-custody procedures. This will assure the integrity of laboratory data by tracking and documenting samples from

the time the samples are collected by the sampling team to the time the samples are analyzed by the laboratory.

5.0 CUSTODY PROCEDURES

Stringent documentation of custody is one of several factors that is necessary for the admissibility of environmental data as evidence in a court of law. Custody procedures help to satisfy the two major requirements for admissibility: relevance and authenticity. Sample custody is addressed in three parts: field sample collection, laboratory analysis, and final evidence files. Final evidence files, including all originals of laboratory reports and purge files, are maintained under document control in a secure area.

A sample or evidence file is under custody if it is:

- in the actual possession of an individual;
- in the view of an individual after being in possession of an individual;
- in actual physical possession but is locked up to prevent tampering; or
- in a designated and identified secure area.

The sample packaging and shipment procedures summarized below will ensure that the samples will arrive at the laboratory with the chain of custody intact.

5.1 Field Custody

The field sampler is personally responsible for the care and custody of the samples until they are transferred or properly dispatched. As few people as possible should handle the samples.

Sample containers will be identified by use of sample tags with sample numbers, project name, date/time of collection, preservative, and type of analysis. The sample numbering system is presented in Section 4.6 of this QAPP. Sample tags are to be completed using waterproof ink unless prohibited by weather conditions.

Chain-of-custody forms will be completed to the full extent possible prior to shipment of samples. The form will include the following information: sample number, time collected, date collected, source of sample (including type of sample), preservative and name of sampler. The forms will be completed in a legible manner using waterproof ink and will be signed by the sampler. When transferring possession of the samples, the individuals relinquishing and receiving will sign, date, and note the time on the record. This record documents transfer of custody of samples from the sampler to another person, to a laboratory, or to/from a secure storage area.

5.2 Transfer of Custody and Shipment

Samples will be properly packaged on ice or "blue ice" at 4°C in an insulated cooler for shipment and dispatched to the appropriate laboratory for analysis, accompanied by a signed chain-of-custody form. Shipping containers must meet applicable State and Federal standards for safe shipment. Shipping containers will be locked and secured with strapping tape and custody seals for shipment to the laboratory. Custody seals will be attached to the front right and back left of the cooler. The custody seals will be covered with clear plastic tape. The cooler will be strapped with tape in at least two locations.

Samples will be transported to the laboratory by overnight carrier or directly by laboratory personnel. Bills of lading or other documentation provided by the carrier shall be retained as part of the permanent documentation. Commercial carriers are not required to sign off on the custody form as long as the custody forms are sealed inside the sample cooler and the custody seals remain intact.

The original chain-of-custody record form will accompany the shipment. A copy of the form will be retained by the PM.

5.3 Laboratory Custody Procedures

Laboratory custody procedures for sample receiving and log-in, sample storage and number, tracking during sample preparation and analysis, and storage of data are described in the Great Lakes Analytical QAP, included as Attachment D to the *Site Investigation Work Plan*.

6.0 EQUIPMENT CALIBRATION

6.1 Field Equipment

Field equipment, such as the photoionization detector (PID) or a flame-ionization detector (FID), used during this field project will be calibrated and operated in accordance with the manufacturer's instructions. Copies of manuals for the equipment will be available at the site at all times during sampling activities.

The PID and FID will be calibrated will be calibrated prior to the initiation of field activities and daily thereafter, using a commercially prepared isobutylene gas standard with a concentration of 100 ppm in air. Documentation of calibrations will be maintained in equipment logs and in field logbooks for the project.

6.2 Laboratory Equipment

Laboratory equipment will be calibrated as outlined in the Great Lakes Analytical QAP, include as Attachment D to the *Site Investigation Work Plan.*

7.0 ANALYTICAL SERVICES

All soil and sediment samples will be analyzed using the U.S. Environmental Protection Agency's (EPA) Test Methods for Evaluating Solid Wastes, Third Edition, (SW-846) for one or several of the following parameters:

- volatile organic compounds (VOCs) using EPA Method 8260 by GC/MS;
- polychlorinated biphenyls (PCBs) using EPA Method 8082;
- cyanide (CN) using EPA Method 9021.
- arsenic (As) using EPA Method 7060;
- lead (Pb) using EPA Method 7421;
- mercury (Hg) using EPA Method 7421
- selenium (Se) using EPA Method 7740; and
- other target analyte list (TAL) metals and tantalum (Ta) using EPA Method 6010.

All ground water samples will be analyzed for:

- VOCs using EPA Method 8260 by GC/MS;
- Pb using EPA Method 7421; and
- Cadmium (Cd) and Ta using EPA Method 6010.

The quality assurance/quality control procedures utilized by the Great Lakes Analytical are presented in their QAP included as Attachment D to the *Site Investigation Work Plan.* The program includes required sample handling procedures, documents the analytical procedures, outlines instrument maintenance and calibration information, details quality control for reporting analytical results, and discusses disposal of samples.

8.0 INTERNAL QUALITY CONTROL

8.1 Field Quality Control Checks

Soil samples will be analyzed in the field using either a PID or a FID. Field analyses are performed in the field and do not involve samples that are collected and retained. The quality control procedures will consist of calibrating the instruments, as outlined in Section 6.0 of this QAPP, and taking multiple readings.

Assessment of field sampling precision and bias will be made by collecting field duplicates for laboratory analysis. Collection of the duplicate samples will be in accordance with the sampling procedures outlined in Section 4.0 of this QAPP and the *Site Investigation Work Plan.*

8.2 Laboratory Quality Control Checks

The laboratory identified in Section 7.0 of this QAPP has instituted a quality control program designed to ensure the reliability and validity of the analyses performed at the laboratory. The internal quality control checks include the following:

- Field duplicates
- Method blanks
- Reagent/preparation blanks (inorganic analysis)
- Instrument blanks
- Matrix spikes/matrix spike duplicates

- Surrogate spikes
- Analytical spikes
- Laboratory duplicates
- Laboratory control standards
- Internal standard areas for GC/MS analysis; control limits
- Mass tuning for GC/MS analysis
- Endrin/DDT degradation checks for GC/EC analysis
- Second, dissimilar column confirmation for GC/EC analysis

9.0 DATA REDUCTION, VALIDATION AND REPORTING

All data generated in field activities or in the laboratory shall be reduced and validated prior to reporting. Data reduction consists of converting raw analytical data to final results with appropriate reporting units. Data validation consists of qualifying analytical/measurement data on the performance of the field and laboratory quality control measures incorporated in the sampling and analysis procedures.

9.1 Field Data

Field data reduction procedures will be minimal. Only direct-read instrumentation will be used in the field. A PID or FID will generate measurements directly read from the instruments following calibration per manufacturer's recommendations, as outlined in Section 6.0 of this QAPP. Data will be entered onto borehole logs or in field logbooks immediately after measurements are taken. Errors will be crossed out, initialed and dated by the field member, and the correct measurement will be recorded in the space adjacent to the incorrect entry.

Field data evaluation will consist of checking to ensure transcription errors are not made when preparing final borehole logs or other documentation based on field documents. This task is the responsibility of an individual, typically the PM or Project Director (identified in Section 2.0 of this QAPP), who has not otherwise participated in making the field measurements or adding information to the field logbook.

All field data recording sheets (such as borehole logs and field logbooks) will be retained. Summarized raw data will be identified in reports.

9.2 Laboratory Data

The raw analytical data for samples collected from the site during the Site Investigation activities, will be reduced, validated, summarized and reported by the Great Lakes Analytical laboratory. The data reduction, validation and reporting procedures are summarized in the Great Lakes Analytical QAP included as Attachment D to the *Site Investigation Work Plan.*

Prior to the release of the analytical data in a public document, the CEI QAO will review the data received from the analytical laboratory in order to confirm that the data appears to reflect expected conditions at the Site.

If the PM and the QAO detect unacceptable data, these individuals will initiate corrective procedures as necessary. Procedures may consist of the following:

- A reanalysis of particular samples, if allowed, based on holding time criteria;
- Collecting new samples for analysis;
- Accepting and documenting a level of uncertainty in the data.

9.3 Performance/System Audit

A performance/system audit of field activities will be conducted to verify that sampling and analysis are performed in accordance with the procedures established in the QAPP and the Site Health and Safety Plan.

Given the relatively short duration of the Site Investigation sampling activities, three field audits will be conducted by the CEI QA Officer during the sampling activities to ensure established sampling procedures are being followed. The audit will include the examination of field sampling records, field instrument operating records, sample collection, handling and packaging, etc. Follow-up audits may be conducted if serious deficiencies are noted in the initial audit.

The Great Lakes Analytical Laboratory Manager will be responsible for conducting a laboratory audit or otherwise ensuring that the laboratory adheres to QA/QC procedures documented in its QAP.

9.4 Data Assessment

Laboratory precision, accuracy and completeness will be assessed by spiking samples in the laboratory and assessing the percent recovered. Completeness will be assessed as discussed in Section 3.3.

10.0 CORRECTIVE ACTION

Corrective action is the process of identifying, recommending, approving and implementing measures to counter unacceptable procedures or out-of-quality control performance which can affect data quality. Corrective action can occur during field activities, laboratory analyses, data validation and data assessment. All corrective action proposed and implemented should be documented in the regular quality assurance reports to management. Corrective action should only be implemented after approval by the CEI PM or the Great Lakes Analytical Laboratory Manager.

Any non-conformance with the established quality control procedures in the QAPP or sampling plan will be identified and corrected in accordance with the CEI's QAPP and Great Lakes Analytical's QAP. The CEI PM or a designee will issue a non-conformance report for each non-conformance condition.

10.1 Corrective Action in the Field

Corrective action in the field may be necessary when a sample network is changed (i.e., more/less samples, sampling locations other than those specified in the QAPP or the *Site Investigation Work Plan*, etc.), or sampling procedures and/or field analytical procedures require modification, etc., due to unexpected conditions. In general, the field staff, PM, or the QUO may identify the need for corrective action. A corrective action will be recommended by either the field staff, the PM or the QAO. It is the responsibility of the PM, in conjunction with the QAO, to ensure the corrective action has been implemented. Corrective actions will be implemented and documented in the field logbook.

10.2 Corrective Action in the Laboratory

Laboratory corrective action may occur prior to, during and after initial analyses. A number of conditions such as broken sample containers, multiple phases, low/high pH readings, and/or potentially high concentrations samples may be identified during sample

log-in or just prior to analysis. Following consultation with lab analysts, it may be necessary for the Laboratory Manager or a designee to approve the implementation of corrective action. Actions may include dilution of samples, additional extract cleanup, automatic reinjection/reanalysiswhen certain quality control criteria are not met, etc. The corrective action will be documented in the laboratory's records and will be documented in the laboratory report sent to CEI's QA Officer. If corrective action does not rectify the situation, the laboratory will contact the CEI PM.

10.3 Corrective Action During Data Validation and Assessment

The facility may identify the need for corrective action during either data validation or data assessment. Potential types of corrective action may include resampling by the field staff or reinjection/reanalysis of samples by the laboratory.

These actions are dependent upon ability to mobilize the field staff, whether the data to be collected is necessary to meet the required quality assurance objectives, etc.

11.0 QUALITY ASSURANCE REPORTS

No separate Quality Assurance report will be generated, given the short duration of the project. The report summarizing the investigation activities will contain a separate QA section discussing the quality of information collected during the project.

ATTACHMENT D
Great Lakes Analytical
Quality Assurance Program

QUALITY ASSURANCE PROGRAM

Great Lakes Analytical
1380 Busch Parkway
Buffalo Grove, IL 60089

Revision: 5.7
Date: February 18, 1998

Signed

Kevin W. Keeley
President

Signed

Deborah Lowe
Laboratory Manager

Signed

Ronald J. Osborn
Quality Assurance Manager

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1. INTRODUCTION

1.1 Quality Statement

Success in the environmental laboratory marketplace is dependent on three factors: quality, service, and price. Of these, quality is the fundamental factor. Quality is the foundation upon which the other two elements are based. If our clients do not have faith in the quality of our measurements then our product has no value to them. Price and service levels are irrelevant. Clearly , providing quality data to our clients must be the highest priority for the staff at Great Lakes Analytical. This commitment to quality starts with the top management of the laboratory. The President communicates this commitment to the analytical staff directly through staff meetings, interviews with new employees, and in the laboratories through daily interactions with the analytical staff. Indirectly, it is communicated to the analytical staff through the goals and objectives set by the President for his managers. Finally this commitment and specific quality criteria are communicated to the staff through this document, the Quality Assurance Program, and through method specific standard operating procedures. At Great Lakes Analytical, service may on occasion, be compromised in the pursuit of quality; but quality is never compromised in the pursuit of service. Our objective is to provide the highest quality data available in the laboratory marketplace, on time, and at an affordable price.

1.2 Definition

A Quality Assurance Program is an organization-wide network designed to assure that data produced within that network conforms to the highest standards set by state and/or federal regulations. The network functions at the management level through company goals and management policies; it functions at the analytical level through standard operating procedures and quality control. These two levels are spanned by data control and the reviewing process. The end result is a data package that is accurate, reproducible, and is presented in such a way as to be most useful to the client.

1.3 Scope

Great Lakes Analytical (GLA) analyzes thousands of environmental and industrial samples every month. Chemical and physical parameters must often be measured on the same sample. As such, the Quality Assurance Program must be able to accommodate the complications implicit in the analysis of many samples of widely varying matrices. Analytical methods employed at Great Lakes Analytical are those approved by the US EPA or state regulatory agencies whenever possible. Source documents for these methods include: the latest approved version of *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods,* SW-846; *Methods for the Chemical Analysis of Water and Wastes,* EPA-600/4-79-020, March 1983; *Methods for the Determination of Organic Compounds in Drinking Water,* EPA-600/4-88/039, December 1988; CFR 40 136 Appendix A; *Standard Methods for the Examination of Water and Wastewater,* APHA, 18 ed. 1992; as well as other state and federal publications.

1.4 Purpose

The Quality Assurance Program (QAP) provides a means by which the integrity of data can be verified. Industrial, engineering, and environmental decisions are based on the data produced, therefore, it is essential that clear and extensive verification procedures exist. Accuracy, precision, completeness, and representative results are all aspects of a data package that verify the integrity of the analysis.

The QAP is also a useful historical document. The chronological development of any program relies on the adequate documentation of previous versions. Improvements and modifications can be instituted only if an established frame of reference exists and the comparative efficacy of such changes can be judged.

Lastly, the Quality Assurance Program is the format through which Great Lakes Analytical can express its goals, policies, and commitment toward the generation of data of the highest quality. It expresses how the laboratory will meet those goals through time, resources, and personnel allocations.

1.5 Revisions

The President and the Quality Assurance Manager will meet annually to review the Quality Assurance Program manual. Each time a revision to the QAP is completed, all analysts and managers will receive a copy. A sign off sheet and/or training will be administered with the QAP. A copy of all the revisions to the QAP is retained for future reference.

2. ORGANIZATION AND RESPONSIBILITY

Great Lakes Analytical has a structure to facilitate communications between the management and analytical levels. This structure ensures that the final data package produced for the client meets or exceeds regulatory standards. The following are brief descriptions of the major organizational levels (Figure 1 in Appendix).

2.1 President

The President reports directly to the Chief Executive Officer and the Board of Directors and is responsible for the overall financial, operational, and quality performance of the Corporation.

It is the responsibility of the President to ensure that the QAP is fully implemented at all times. The Quality Assurance Manager reports directly to the President and assists him in monitoring the implementation of the QAP. It is the responsibility of the Laboratory Manager to implement the QAP. The President mediates any conflicts that may arise in the interpretation of methods or the QAP between these two managers.

It is the responsibility of the President to ensure that the Chemical Hygiene Plan is fully implemented at all times and that a safe workplace and work practices are maintained. The Health and Safety Manager assists the President in this function.

The Vice President of East Coast operations also reports directly to the President.

2.2 Quality Assurance Manager

The Quality Assurance (QA Manager) is responsible for: overseeing and reviewing the Quality Assurance Program; all quality control procedures; internal checks and audits; QC data reporting; monitoring employee training; providing required QA/QC related training; and interfacing with the external auditors. The QA Manager updates the laboratory on changes to method requirements and procedures, and is responsible for controlling documentation of written procedures and audits.

The Quality Assurance Manager is also responsible for maintaining the laboratory's certifications and keeping abreast of changes in the programs in which the laboratory participates.

2.3 Health & Safety Manager

The Health and Safety Manager is responsible for overseeing the Health and Safety program. This includes routine internal health and safety audits of the facility as well as management of the Hazardous Waste Program. The Health and Safety Manager is also responsible for reviewing, revising, and providing training for the Chemical Hygiene Plan.

2.4 Laboratory Manager

The Laboratory Manager is responsible for all aspects of laboratory operations including the implementation of the QAP. This includes the selection and promotion of staff, the purchase of equipment and instrumentation and the interpretation of analytical methods. The Laboratory Manager is also responsible for overseeing the activities of the Analytical Department Managers.

The Laboratory Manager is also responsible for overseeing the activities of the Project Managers through the Client Services Manager. The Laboratory Manager plays a crucial role in working with this department to resolve service problems. This includes ensuring that all client needs are met and setting appropriate priorities for analytical work.

2.5 Client Services Manager

The Client Services Manager (CSM) is responsible for ensuring that our clients receive the highest levels of service available. The CSM is assisted in this activity by the Project Managers, Department Managers Log-In staff and the Drivers. The CSM works with the QA Manager to ensure that the QAP is implemented in the Log-In and Project Management areas. The CSM works with the Lab Manager in setting staffing levels and making major equipment purchases in the department. The CSM also works closely with the Analytical Department Managers to resolve service problems. This includes ensuing that all client needs are met and suggesting appropriate priorities for analytical work.

2.6 Analytical Department Manager

There are three Analytical Department Managers: Inorganics, Semi-Volatile Organics and Volatile Organics. The Analytical Department Managers are responsible for the day to day operation of their departments. This includes the scheduling of work, technical oversight, staff training, routine purchasing, budgeting, and the implementation of the Quality Assurance Program and the Chemical Hygiene Plan within their department. The Analytical Department Manager also works with the Lab Manager in establishing staffing levels and making major equipment purchases. The Department Manager also works closely with the individual analysts in troubleshooting and in developing and validating new methods. The Department Manager also reviews the data generated in their department for SOP and QAP compliance.

2.7 Project Manager

The Project Manager is the primary contact for Great Lakes Analytical's clients. The Project Manager works with the analytical staff and clients in resolving problems originating in log-in, analytical departments, or administrative areas. The Project Manager works closely with the administrative staff in reviewing reports for typographical errors, and ensuring that client specific reporting requirements are met. The project Manager is responsible for keeping the client appraised in the progress of their projects.

2.8 Analyst/Extraction Analyst

An analyst is responsible for all aspects of assigned analytical procedures, including overseeing sample preservation and preparation, performing the analysis, and reporting the results. Included in this is the adherence to all quality control procedures specified in the analytical methods or standard operating procedures and the full documentation of these procedures. The analyst has the responsibility and authority to stop analysis or withhold a result if quality control objectives are not met or resolved according to applicable standard operating procedures or their manager. In addition, the analyst is responsible for routine maintenance as well as documentation of that maintenance, of their equipment and for having sufficient supplies for analysis. Furthermore, each analyst is responsible for performing their job functions in compliance with the Chemical Hygiene Plan and for proper disposition or disposal of chemicals and samples.

2.9 Technician

The technicians are responsible for both laboratory and field support. Under the supervision of their manager, they are responsible for proper sample pick-ups, deliveries, and general laboratory support. In addition, they are responsible for bottle preparation in accordance with all quality control procedures and relevant standard operating procedures. Each Technician is responsible for performing their duties in compliance with the Chemical Hygiene Plan and for the proper disposition or disposal of chemicals and samples.

3. CERTIFICATION

Great Lakes Analytical has the following certifications:

- American Association of Laboratory Accreditation. Certification scope for Environmental Analysis, Environmental Lead and Drinking Water Analysis.
- Army Corps of Engineers (USACE); HRTW Program. (Re-Certification Pending)
- Environmental Lead Proficiency Analytical Testing Program; Lead in Paint Chips, Soil and Wipes.
- Illinois Environmental Protection Agency; Drinking Water Analysis.
- New Jersey Department of Environmental Protection -
- New York Department of Health; Potable and Non-Potable Water.
- New York Department of Health; Solid and Hazardous Waste.
- Delaware Health and Social Services-Division of Public Health; Approval for Drinking Water Analysis.
- Commonwealth of Pennsylvania Department of Environmental Resources; Drinking Water.
- Tennessee Department of Health; Drinking Water and UST Approval.
- Wisconsin Department of Natural Resources; hazardous waste analysis under NR 149.
- Commonwealth of Virginia- Division of Consolidated Laboratory Services; Certified Drinking Water Laboratory.

3.1 Personnel Summary

Total Staff.....41
Total Scientific Staff.....26

3.2 Degrees

BA/BS.....96%
MS 4%

3.3 Undergraduate and Graduate Degrees Awarded

Chemistry
Biology
Physics

4. CLIENT COMPLAINTS

Client complaints can come to Great Lakes Analytical through various routes: Log-in personnel, Project Managers, the Client Services Manager, Marketing Associates, or the Laboratory Manager. It is the goal of Great Lakes Analytical to carefully listen to these issues and devise strategies that will prevent these problems from recurring.

When a complaint is received it is immediately brought to the attention of the Laboratory Manager. Support documentation is then assembled by the recipient of the complaint and evaluated by the Laboratory Manager the Client Services Manager or QA Manager. After a clear understanding of the problem has been reached, appropriate corrective actions are taken to resolve the client's complaint. These corrective actions are communicated to the client by the QA/Manager, Lab Manager,, Project Manager, CSM, President or other appropriate member of the staff.. The Laboratory Manager is responsible for implementation of the corrective action. The QA Manager will do an annual report summarizing these corrective actions and present it to the Laboratory Manager for review and further corrective actions if warranted.

5. SAMPLING

Sampling is an important part of any analysis. The result may be only as useful as the quality of the sampling effort. Great Lakes Analytical only performs limited sampling for it's clients, but does provide sampling containers and advises clients if requested of proper sampling procedures, containers and preservation techniques.

5.1 Sampling Containers and Preservation

Containers are purchased in large lots from various commercial sources and are equivalent in terms of construction materials and cleaning protocols, to those listed in "Specifications and Guidance for Contaminant-Free Sample Containers", EPA Document 93963316, December 1992. Containers are prepared in a designated area, labeled with the preservative added, affixed with a sample description label, and stored.

Samples brought to Great Lakes by clients who have done their own sampling, are checked for appropriate preservatives, corrected if possible, documented and stored upon arrival. Preparation of containers is done by technicians relying on Standard Operating Procedures for Bottle Preservation(Refer to the SOP for Receipt of Samples into the Laboratory). Sample containers are provided to clients with the appropriate preservatives as part of the analytical process. SOP's for drinking water sampling procedures are provided to clients who upon request .

6. CHAIN OF CUSTODY

The chain of custody is the documented history of any sample. It begins at the sample site with the sampling personnel, continues on with the sample through transport to the laboratory, where it is received and stored under the custody of the laboratory. An example of Great Lakes Analytical's chain of custody may be found in Figure 3 in the Appendix.

6.1 Laboratory Receipt Documentation

When the samples are received by the laboratory, the personnel in Sample Control check to ensure that all samples listed on the chain of custody are, in fact, present and in satisfactory condition. They sign and date the chain of custody form and store the samples appropriately in an area that is restricted to Great Lakes Analytical staff only.

In the case where samples are brought in by clients without a chain of custody form, Great Lakes will provide a blank form and then a copy of the completed, signed version of the form to the client.

6.2 Sample Integrity Documentation

In addition to ensuring that the sample is fully documented , the Sample Control personnel are responsible for determining if there is sufficient sample to do the analyses requested, that they are preserved appropriately, and that holding times have not been violated.

They are also responsible for splitting those samples that have multiple analyses scheduled, and for compositing. Problems with sample integrity or paperwork inconsistencies are reported to the Client Services Manager or the client's Project Manager who will take corrective action.

6.3 Sample Log-in

Upon being received at Great Lakes Analytical, each sample container is given a unique sample number and stored appropriately in cold storage or at room temperature in an orderly fashion to ensure that the analyst may quickly find the appropriate container for their analysis. Each of these unique sample numbers are entered into laboratory records along with the client's name, the general analytical departments associated with the analytical requests, the turnaround status, and whether the sample is in acceptable condition or not. An example of a log-in form can be found in Figure 4 in the Appendix. The log-in procedures are covered in the SOP for Receipt of Samples into the Laboratory.

6.4 Hazardous Samples

Hazardous samples are segregated from other samples and from each other by hazard class. These samples are Red-Tagged to identify them as hazardous to all possible handlers. The Red-Tag is a label, with a written description of the hazard, affixed to the sample container. Examples of the hazardous classes include Flammable, Asbestos, PCB's, Cyanides, and Acids. All hazardous samples are disposed of appropriately. Procedures and requirements for Red-Tagging samples are given in the SOP for the Handling of Hazardous Samples and the Chemical Hygiene Plan.

6.5 Sample Storage

Samples are kept in house for 4-6 weeks after analysis unless special arrangements have been made by the client. Storage areas are organized numerically in library fashion. Samples that do not require cold storage are maintained on shelving units. Refrigerated storage areas are maintained at 4 degrees Celsius. Samples are rotated out of the refrigerated storage and onto the shelving units after the originally requested analyses are completed. Daily temperature records are kept for every refrigeration unit.

Analysts and technicians retrieve the sample container allocated to their analysis from storage, analyze the sample, and return it to the shelf from which it originally came. After 6 weeks of storage, samples are removed from the shelves and disposed of appropriately, unless otherwise specified by the client. Records are kept of sample disposal dates.

6.6 Sample Shipping

In the event that Great Lakes needs to ship samples, the samples are placed in a cooler with enough ice to ensure the maintenance of 4 degrees C. The samples are carefully surrounded by packing to avoid breakage and a trip blank is enclosed for those samples to be analyzed for volatile organic compounds. The chain of custody is signed over to the courier and attached to the shipping paperwork. Samples are generally shipped overnight express or hand delivered by a Great Lakes Analytical courier to maintain sample integrity.

7. STANDARD OPERATING PROCEDURES

Standard operating procedures are a central element in the QA/QC program at Great Lakes Analytical. The SOP's serve a number of useful and necessary functions. The first is method conformance. Each SOP has been prepared to ensure that all technical and QC requirements of the source document are met or properly amended. SOP's are also useful as training documents. New analysts study the applicable SOP's before receiving training from senior analysts. SOP's are much more specific than source methods which may be applicable to a wide variety of matrices and types of instrumentation. The SOP is specific to the type of matrix commonly encountered, the equipment types available and the procedure followed at GLA. One of the most important aspects of SOP's is as historical documents. Each revision of an SOP has specific applicable dates.

7.1 Format

All Standard Operating Procedures for laboratory methods will include but are not limited to the following sections or reference where they can be found.

Applicability	Sample Management	Safety
Summary	Method Validation	Quality Control
Equipment	Standards and Reagents	Interferences
Procedure	References	Record Keeping
	Maintenance and Troubleshooting	

SOP's serve to consolidate the many different source documents and procedures used by GLA into an easily accessible guide for the analysts. One SOP may be written for multiple methods that contain identical formats except for the procedure sections. In this case, separate procedures will be written for the different analyses or matrices. In some cases the methods are performed exactly as written and will serve as the SOP.

7.2 Revisions

Periodically or as equipment or accepted methodologies change, Standard Operating Procedures will be revised. Proposed revisions to SOP's or new SOP's will be reviewed and approved by the appropriate managers for that procedure. In the case of analytical method SOPs the Department Manager, the QA Manager, and the Laboratory Managers approval is required prior to introduction into the laboratory.

7.3 Deviations

Any deviation from Standard Operating Procedures must receive prior approval from the Laboratory Manager or the President. The QA Manager will be notified of all changes in order to check compliance with the original document. Deviations are accepted for unique matrix considerations or special non-standard analytical requests by Great Lakes Analytical clients. Deviations for other reasons may necessitate a revision to the SOP.

8. ANALYTICAL QUALITY CONTROL

Quality control measurements verify the integrity of the analytical results. While the goal of all quality control procedures remains constant, specific quality control procedures vary from method to method, and to some extent, with matrix type. Each analyst is responsible for a thorough understanding of the goals of the Quality Assurance Program, as well as how the program is implemented in each method. The analyst is also responsible for the documentation of all quality control measurements associated with a particular method. All records, reports and documentation are kept for a minimum of 5 years.

Great Lakes Analytical adheres to the quality control procedures set out in the latest approved version of *EPA SW-846* for the majority of analytical procedures. Great Lakes also adheres to any additional quality control procedures set out in a particular method. Other method references may include the Illinois Title 35, Wisconsin Department of Natural Resources NR 149, *Code of Federal Regulations* Title 40, and *Standard Methods*, 18th Edition, 1992.

8.1 Calibration

8.1.1 Calibration for Organic Analyses

EPA Method 8000B from *EPA SW-846*, is a general introduction to the quality control requirements for gas and liquid chromatography. It is followed by more specific methods developed for specific organic compounds. Great Lakes Analytical uses EPA Method 8000 and the specific EPA method to set-up the required quality control measures for each analysis. Standard operating procedures for the analytical methods and all quality control documentation measures are kept in the analysts' notebooks and reference binders.

The majority of organic instrumentation is calibrated with internal standards. Some instruments, because of the complex nature of the multi-peak chromatograms produced by the method, necessitate the use of external standard calibration. Surrogate compounds are included in the calibration processes for all organic analyses if applicable.

Initially, each instrument is calibrated for the method for which it is allocated. Once the operating parameters have been established according to the method, the analyst prepares standard solutions containing all the analytes of interest, any internal standards, and any surrogates that are appropriate for the method.

These standard solutions are prepared at different concentrations. One of the concentrations must be just above the detection limit and the others should define the linear range for the instrument. All of the standard solutions are prepared using Class A volumetric glassware and the highest quality solvents and stock standards commercially available. The number of standards prepared is determined by the requirements of the particular method. If there are no specific requirements then GLA will default to three standards.

All standards are purchased from commercial suppliers, dated upon receipt and replaced according to the methodology. A standards log is kept containing the analytes, supplier, lot number, concentration, any dilutions made, expiration date and a unique code to identify the standard. The documentation of the use of the standard is accompanied by the code at every entry in the analyst's notebook.

The standard solutions are introduced into the instrument in the same manner in which the sample or the sample extract would be introduced whether it be by purge and trap or by direct injection. The calibration factor (CF) for those methods that use external standards and the response factor (RF) for those methods that use internal standards are calculated.

Calibration Factors and Response Factors are calculated as follows:

$$\text{Calibration Factor} = \frac{\text{Total Area of Peak}}{\text{Concentration or mass of analyte injected}}$$

$$\text{Response Factor} = \frac{(\text{Area of Analyte})(\text{Conc. of Internal Standard})}{(\text{Area of Internal Standard})(\text{Concentration or mass of Analyte})}$$

The CF's or RF's for each of the concentrations for each of the analytes, internal standards, and surrogates are tabulated. The CF's or RF's for each analyte, internal standard, or surrogate should have a Percent Relative Standard Deviation (% RSD) of less than 20%. The % Relative Standard Deviation is calculated as follows:

$$\%RSD = (SD/x) \times 100$$

Where:

SD = Standard Deviation of initial CF's or RF's for each compound.

x = Mean of initial CF's or RF's for each compound.

If the % RSD is less than 20%, the calibration curve can be considered linear through the origin. If the method specifies different criteria (i.e. Method 624), then that criteria will be utilized. If the % RSD is greater than 20%, additional calibration data must be collected or a non-linear calibration curve may in some cases be used.

The initial calibration curve is further verified by the use of a secondary standard source. The analyst prepares a secondary source standard solution of a mid-range concentration in the same manner as the previous standard solutions was prepared. The secondary source solution is introduced into the instrument in the same manner as the samples and the calibration solutions. Using the calibration factors or response factors generated in the original calibration, the concentration of the analyte in the secondary source standard must be within 15% of the true value for that compound.

The validity of the calibration curve must be checked daily for most instruments and more frequently for instruments with particularly sensitive detectors that tend to drift. The analyst prepares a daily calibration check standard solution in the same manner as the initial calibration standard solutions were prepared. The daily calibration check standard solution must be within 15% of the true value.

Some methods have prescribed limits set for the recoveries listed above that may be different. It should be noted that individual method specifications would override these general procedures. In addition, there may be calibration procedures prescribed in the method, such as GC/MS tuning with BFB or DFTPP, that are not described here in detail but are described in detail in the standard operating procedures for the method.

8.1.2 Calibration for Inorganic Analyses

EPA SW-846, *Standard Methods for the Examination of Water and Wastewater 18th Edition 1992,* and USEPA CLP Statement of Work for Inorganic Analysis ILM01.0 are the three source documents used by Great Lakes Analytical to develop the quality control measures for inorganic analyses.

GLA uses all three to develop minimum performance standards. Standard operating procedures for the analysis and the quality control documentation measures are kept in the analysts' notebooks and reference binders. The majority of inorganic instrumentation is calibrated with external standards. The calibration procedures are much the same for inorganic as they are for organic methods. Please refer to section 7.1.1 above. Because of the nature of the technology and greater volume of samples capable of being analyzed during a 24 hour period, inorganic calibration curves are checked on a more frequent basis.

8.2 Retention Time Windows

Most organic analyses use gas chromatography or liquid chromatography instrumentation. As the key to analyte identification in chromatography, retention time windows must be established for every analyte in a particular method on every column used for that method. These records are kept with the notebooks associated with an instrument for later identification and quantitation of the analytes.

Once the analyst has determined that the instrument is in optimum working order through calibration and calibration verification procedures, the analyst uses a mid-range calibration standard to establish the retention times of the individual analytes in a method. The analyst makes 3 injections of the same standard over a 72 hour period, tabulating the retention times for each analyte for each of the 3 injections. The standard deviation of the retention times is then calculated. The retention time window is defined as the average retention time from the daily check standard plus or minus 3 Standard Deviations.

Other criteria has been established and documented for methods that do not allow practical application of RT Windows. As stated in EPA SW846 Rev. 2 & 2A 1992, Method 8000 section 7.5.2.1 "Plus or minus three standard deviations of the retention times for each standard will be used to determine the retention time window; however, the experience of the analyst should weigh heavily in the interpretation of chromtograms."

8.3 Quantitation

Organic compounds analyzed by chromatography are tentatively identified by comparing retention times of the sample and the standard. Under most conditions, tentatively identified compounds must be confirmed on a second column of different affinity. Sample quantitation procedures and calculations are outlined in each method depending on the type of calibration used for the method. Instrumentation parameters are documented in the analysts' notebooks.

Similarly inorganic analytes are identified and quantitated by comparing the response of the analyte to the response of the standard. Confirmation is not always possible, although some methods, like metals analyses, allow for a secondary check under a different set of instrument operation parameters. All calculation and instrument operating parameters are recorded in the analysts' notebooks or the SOP.

8.4 Method Detection Limit Verification

The method detection limit (MDL) is determined for each analyte on each instrument allocated to a method on an annual basis. The procedure and requirements for establishing MDL's is taken from 40 CFR Part 136, Appendix B. The analyst prepares at least seven replicates of solution spiked at up to five times the lowest reproducible calibration standard with all the analytes of interest. Each of these aliquots is subjected to the entire analytical process. The Standard Deviation (SD) of seven replicates is calculated. The method detection limit is calculated as follows:

$$\text{Detection Limit} = t_{(n-1,\ 1-a\ =\ 0.99)} \times SD$$

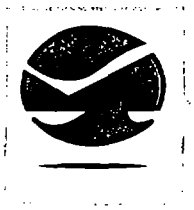
where $t_{(n-1,\ 1-a\ =\ 0.99)}$ is Student's T value which is 3.143 for seven replicates. Great Lakes Analytical establishes three distinct limits for reporting purposes. They are:

Method Detection Limit (MDL) - As explained above, this limit is established by the procedure in 40CFR Part 136 App. B. The calculated MDL can not be greater than the concentration of the standard, nor can it be < 10% of the concentration of the standard used in the study.

Practical Quantitation Limit (PQL) - The PQL is the level above which quantitative results can be obtained with a specific degree of confidence. The PQL is established at ten times the standard deviation from the MDL study. The procedures for establishing the PQL is taken from "Principles of Environmental Analysis" , *Analytical Chemistry*, Vol. 55, No. 14, December 1983, 2210-2218.

ENVIRONMENTAL, INC.

ATTACHMENT E
Site Health and Safety Plan



SITE HEALTH AND SAFETY PLAN

Fansteel, Inc.
Number One Tantalum Place
North Chicago, Illinois

Prepared by
CARLSON ENVIRONMENTAL, INC.
312 West Randolph Street
Suite 300
Chicago, IL 60606
(312) 346-2140

Project No. 9566
April 1998

TABLE OF CONTENTS (Continued)

LIST OF ATTACHMENTS

REVIEW AND APPROVAL

PROJECT MANAGER

Margaret M. Karolyi	_____	CEI	_____
	Signature	Company	Date

SITE SUPERVISOR

_____	_____	CEI	_____
to be assigned	Signature	Company	Date

HEALTH AND SAFETY OFFICER

_____	_____	CEI	_____
Valerie Baxa	Signature	Company	Date

SITE HEALTH AND SAFETY PLAN ACKNOWLEDGMENT

I have read, understand, and agree to abide by the provisions as detailed in this Site Health and Safety Plan prepared by Carlson Environmental, Inc. Failure to comply with these provisions may lead to disciplinary action and/or my dismissal from the work site.

Printed Name	Signature	Date

1.0 EMERGENCY INFORMATION

1.1 Public Agencies

FIRE	911
AMBULANCE	911
POLICE	911
HOSPITAL	911

HOSPITAL LOCATION SEE ATTACHMENT A
US Veterans Medical Center
3001 Green Bay Road
North Chicago, Illinois 60064-3048
(847) 688-1900

Note: The location and telephone number for this hospital should be reconfirmed prior to beginning each new phase of work at the subject site.

1.2 Key Personnel

PROJECT MANAGER	Carlson Environmental, Inc.
Margaret M. Karolyi	(312) 704-8843 or (773) 491-1484
SITE SUPERVISOR	Carlson Environmental, Inc.
_____	_____
to be assigned	
HEALTH AND SAFETY OFFICER	Carlson Environmental, Inc.
Valerie Baxa	(312) 704-8844 or (773) 491-1479

2.0 INTRODUCTION

2.1 Objective

The activities detailed in the *Site Investigation Work Plan* are intended to comply with the request from the United States Environmental Protection Agency (EPA) to conduct an investigation, as outlined in a letter to The Fansteel Corporation dated June 17, 1997.

As outlined in the EPA's letter, the proposed Site Investigation is to accomplish the following two goals:

- Identify the nature and extent of potential contamination on the Fansteel facility, including any potential contamination that may be contributing to the ground water contamination identified at the adjacent Vacant Lot Site (especially potential sources of trichloroethene); and

- Conduct additional sampling of the sediments of Pettibone Creek to determine the nature and extent of the sediment contamination.

2.2 Chemical Hazards

Based on the site investigation completed at the vacant parcel located adjacent to and south of the subject property, it is anticipated that elevated levels of trichloroethene (TCE, also known as trichloroethylene), cadmium, and lead will be encountered during subterranean investigations of the subject site. In addition, elevated concentrations of tantalum may also be encountered at the subject site. Please refer to Attachment B, Chemical Information, for the Material Safety Data Sheets (MSD Sheets) for these compounds.

Unknown chemical hazards may include elevated concentrations of other volatile organic compounds (VOCs) in addition to TCE, and other metals in addition to cadmium, lead, and tantalum.

2.3 Site Description

The Fansteel North Chicago facility is located at Number One Tantalum Place, approximately two miles east of the intersection of Martin Luther King Jr. Street and U.S. Highway 41, in North Chicago, Lake County, Illinois. The site is bounded by the North Chicago Refiners and Smelters facility to the east, Martin Luther King Jr. Street and the Federal Chicago plant to the south, the Vacant Lot Site to the west, and a the Elgin, Joliet & Eastern (EJ&E) Railroad to the north.

The site consists of an older plant complex located on an approximately eight-acre parcel. There are approximately ten brick buildings on the site, some of which are multi-story buildings. In addition, a transite building and a few aluminum buildings are present on the site. Total gross floor space is reported as 325,500 square feet.

The portions of the property not covered by building are generally asphalt- or concrete-paved and are used as parking lot areas or access ways. Two large upright above-ground tanks are located at the northern end of the property. A railroad spur is located just inside the eastern edge of the site, and an elevated railroad siding is located just south of the above-ground tanks. The entire site is fenced, and there is some vegetation, consisting of grass and bushes, between the office area and Martin Luther King Jr. Street.

The site topography is essentially flat, although on the east site the site is raised near the fence line, sloping down into the parking lot. The building is raised compared to the parking lot, and the railroad spur on the east side is several feet below the site grade. The railroad property north of the site slopes steeply downwards toward the site.

2.4 Policy Statement

It is the policy of Carlson Environmental, Inc. (CEI) to provide a safe and healthful work environment for all of its employees and subcontractors. CEI considers no phase of operations or administration to be of greater importance than injury and illness prevention. Safety takes precedence over expediency or shortcuts. CEI believes every accident and every injury is avoidable. CEI will take every reasonable step to reduce the possibility of injury, illness, or accident.

This SHSP prescribes the procedures that must be followed by all site personnel while on the project site. Operational changes which could affect the health or safety of personnel, the community, or the environment will not be made without prior approval of the Project Manager, and health and safety personnel.

The provisions of this plan are mandatory for all of the personnel and subcontractors assigned to the project. CEI requires all visitors to any work site to abide by these procedures. Work conditions can change as operations progress. The Health and Safety Officer will provide written addenda to this SHSP when changes warrant. No changes to the plans will be implemented without prior approval of the Health and Safety Officer or his authorized representative.

This SHSP was developed to be consistent with current applicable laws and regulations as of April 1, 1998. If laws or regulations change, this SHSP should be updated to comply.

2.5 References

This SHSP complies with applicable Occupational Safety and Health Administration (OSHA) and Environmental Protection Agency (EPA) regulations. This plan follows the guidelines established in the following documents:

(a) *Standard Operating Safety Guides* (US EPA November 1984);
(b) *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities* (NIOSH 85-115);
(c) Title 29 of the Code of Federal Regulations, Parts 1910 (29 CFR 1910) and 1926 (29 CFR 1926); (US DOL/OSHA)
(d) 35 Illinois Administrative Code 742, *Tiered Approach to Corrective Action Objectives*

3.0 RESPONSIBILITIES

3.1 All Personnel

All personnel are responsible for continuous adherence to these health and safety procedures during the performance of their work. No person may work in a manner that conflicts with the intent of, or the inherent safety and environmental precautions expressed in these procedures. After due warnings, CEI's designated agents will dismiss from the site any person who violates safety procedures. CEI's employees are subject to progressive discipline and may be terminated for continued violations. All on-site personnel will be trained in accordance with both 29 CFR 1910.120, and this document.

3.2 Health and Safety Officer and On-Site Safety Coordinator

The project Health and Safety Officer is responsible for developing and coordinating the SHSP and addenda as required. This plan complies with 29 CFR 1910.120 in all respects and includes medical surveillance and training requirements, hazard assessment, personal protective equipment specifications, field implementation procedures, and audits. The Health and Safety Officer will issue addenda to the SHSP if warranted by changed conditions. The Health and Safety Officer and his designee report to the Project Manager for operational matters. The Health and Safety Officer is the contact for regulatory agencies on matters of safety and health. Other Health and Safety Officer responsibilities include:

- General Health and Safety program administration;

- Determining the level of personnel protection required;
- Updating equipment or procedures based on information obtained during site operations;
- Establishing air monitoring parameters based on expected contaminants;
- Establishing employee exposure monitoring notification programs;
- Investigating significant accidents and illnesses and implementing preventative measures, if necessary;
- Performing regular site inspections; and
- Developing site-specific employee/community emergency response plans, as required, based on expected hazards.

3.3 Project Manager

The Project Manager is ultimately responsible for ensuring that all project activities are completed in accordance with requirements set forth in this SHSP.

3.4 Site Supervisor

The Site Supervisor supervises all activities at the site and is responsible for field implementation of the SHSP. This includes communicating site requirements to all personnel, ensuring field supervisors and subcontractors enforce all provisions of the plan, and consulting with the Health and Safety Officer regarding changes to the SHSP. Other responsibilities include:

- Reading and becoming familiar with this SHSP and CEI's policies and procedures;
- Enforcing the SHSP and other safety regulations;
- Stopping work as required to ensure personal and environmental health and safety;
- Determining evacuation routes, establishing and posting local emergency telephone numbers, and arranging emergency transportation;
- Ensuring that all site personnel and visitors have received the proper training and medical clearance prior to entering the site (See Section 7 of this plan.)
- Establishing Exclusion, Contamination Reduction and Clean Zones (See Section 8 of this plan);
- Presenting tailgate safety meetings and maintaining attendance logs and records;
- Assuring that the respiratory protection program is implemented (See Section 6 of this plan);
- Assuring that decontamination procedures meet established criteria;
- Assuring that there is a person qualified to administer first aid on site;
- Discussing potential health and safety hazards with the Health and Safety Officer; and

- Implementing changes as directed by the Health and Safety Officer and Project Manager.

3.5 Subcontractors

On-site subcontractors and their personnel are responsible for understanding and complying with all site requirements. Subcontractors are required to follow the guidelines established in the SHSP.

3.6 On-Site Personnel and Visitors

All on-site personnel and visitors are required to comply with the provisions of the SHSP and all applicable Federal, State and local regulations. Each person is responsible for their own health and safety, for completing tasks in a safe manner and for reporting any unsafe acts or conditions to his supervisor or CEI's designated representative. Personnel will monitor themselves and their fellow employees for signs and symptoms of heat/cold stress and chemical exposure.

4.0 JOB HAZARD ANALYSIS

4.1 Scope of Work

Specific field activities associated with any subterranean investigations may include emplacing soil borings, soil sampling, constructing ground water monitoring wells, and ground water sampling, as necessary.

4.2 Job Safety Analysis

The Job Safety Analysis identifies potential safety, health, and environmental hazards and provides for the protection of personnel, the community and the environment. Because of the complexity and constant change of this type of project, supervisors must continually inspect the work site to identify hazards which may harm site personnel, the community, or the environment. The Project Manager and Site Supervisor must be aware of these changing conditions and discuss them with the Health and Safety Officer. The Health and Safety Officer will write addenda to change Job Safety Analysis and associated hazard controls as necessary.

4.2.1 Soil Boring and Sampling Activities - Specific field activities associated with any subterranean investigations may include emplacing soil borings, soil sampling, constructing ground water monitoring wells, and ground water sampling, as necessary. Hazards connected with these activities include dangers associated with the operation of heavy machinery (i.e a probing machine or drill rig) and the potential for exposure to unknown contaminants while collecting samples. On-

site personnel will wear steel-toed boots, hard hats, safety glasses and protective sampling gloves to reduce their potential for harm. On-site personnel will also be instructed to be aware of drilling activities, listen for backup alarms and keep a safe distance from the boring while the drill rig is operating.

Either a photoionization detector (PID) or an organic vapor analyzer (OVA) will be used to monitor conditions in the breathing zone during any subterranean investigations. If the ambient air PID/OVA readings in the breathing zone exceed the background level by 5 ppm or more, Level C personal protective equipment (including cartridge respirators) will be worn by all personnel. If the ambient air PID/OVA readings in the breathing zone exceed the background level by 100 ppm or more, Level B personal protective equipment (including supplied air respirators) will be worn. Refer to Section 6.2 for more information on Level C and Level D personal protective equipment.

The following constituents were identified at high enough levels, during previous investigations at the subject site to warrant concern: lead, cadmium and trichloroethene.

4.3 Hazardous and Toxic Materials

Uncommon hazards connected with this project are mostly associated with the potential for exposure to TCE, cadmium, lead, and tantalum. Included in Attachment B are the MSD Sheets for these compounds. These tables will be developed as information becomes available during the project.

4.4 Heat and Cold Stress

Wearing personal protective equipment puts a hazardous waste site worker at considerable risk of heat stress. Heat stress effects range from mild heat fatigue to serious illness and death. Heat stress is caused by several interacting factors, including environmental conditions, clothing, work load, and the individual characteristics of the worker. Because heat stress is the most common and potentially serious illness at hazardous waste sites, preventive measures and alertness to the signs and symptoms are vital.

Heat stress monitoring should begin when personnel are wearing PPE, including Tyvek® coveralls, and the ambient temperature exceeds 21°C (70°F). If impermeable garments are not worn, heat stress monitoring should begin at 29°C (85°F).

4.5 Confined Space Entry

Confined spaces are any enclosed area not designed for human occupancy with limited means of

entry and egress, and insufficient ventilation to ensure that the space has a safe atmosphere. Confined space entries are not anticipated during subterranean investigations. If subsequent phases of investigation or remediation activities require confined space entry, CEI's confined spaced entry and safety procedures will be employed. These procedures should be based on OSHA's Standard on Confined Spaces (*58 Federal Register 4462*).

4.6 Dust Control and Spill Control

During subterranean investigations, contaminated dust could pose a potential hazard, because of this, dust control and suppression may be necessary to protect personnel, the community, and the environment. Depending on the moisture content of the exposed site soils, the application of water may be necessary to control and suppress dust from dry, exposed soil surfaces.

Due to the very low potential for the use of potentially hazardous liquids in this project, the need for spill control is not anticipated.

4.7 Hearing Conservation

All personnel on site will wear hearing protection while operating heavy equipment. If on-site personnel are subjected to noise exceeding an 8-hour, time-weighted average sound level of 90 dBA (decibels on the A-weighted scale), feasible administrative or engineering controls will be utilized. In addition, whenever noise exposure equals or exceeds an 8-hour, time-weighted average sound level of 85 dBA, a hearing conservation program, as described in 29 CFR 1910.95, will be employed.

5.0 SAFETY PROGRAM

The following procedures are mandatory for all of CEI's and subcontractor personnel. All site visitors entering Exclusion Zones must follow these procedures. Personnel not following procedures will be warned. If they refuse to follow these procedures, they will be escorted from the site.

5.1 General Practices

- At least one copy of this plan will be available at the job work site.
- At least one person trained in a minimum of basic first aid and CPR will be on site whenever remediation activities occur. As an alternative, this requirement is satisfied when a 911 emergency responder can respond within five (5) minutes to the site.
- No food, beverages, tobacco products will be present, consumed or used in contaminated

SITE HEALTH AND SAFETY PLAN

Fansteel, Inc.
Number One Tantalum Place
North Chicago, Illinois

Prepared by
CARLSON ENVIRONMENTAL, INC.
312 West Randolph Street
Suite 300
Chicago, IL 60606
(312) 346-2140

Project No. 9566
April 1998

ENVIRONMENTAL, INC.

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LIST OF ATTACHMENTS

REVIEW AND APPROVAL

PROJECT MANAGER

Margaret M. Karolyi	_____	CEI	_____
	Signature	Company	Date

SITE SUPERVISOR

_____	_____	CEI	_____
to be assigned	Signature	Company	Date

HEALTH AND SAFETY OFFICER

_____	_____	CEI	_____
Valerie Baxa	Signature	Company	Date

SITE HEALTH AND SAFETY PLAN
ACKNOWLEDGMENT

I have read, understand, and agree to abide by the provisions as detailed in this Site Health and Safety Plan prepared by Carlson Environmental, Inc. Failure to comply with these provisions may lead to disciplinary action and/or my dismissal from the work site.

Printed Name	Signature	Date

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AMBULANCE	911
POLICE	911
HOSPITAL	911

HOSPITAL LOCATION SEE ATTACHMENT A
US Veterans Medical Center
3001 Green Bay Road
North Chicago, Illinois 60064-3048
(847) 688-1900

Note: The location and telephone number for this hospital should be reconfirmed prior to beginning each new phase of work at the subject site.

1.2 Key Personnel

PROJECT MANAGER	Carlson Environmental, Inc.
Margaret M. Karolyi	(312) 704-8843 or (773) 491-1484
SITE SUPERVISOR	Carlson Environmental, Inc.
to be assigned	
HEALTH AND SAFETY OFFICER	Carlson Environmental, Inc.
Valerie Baxa	(312) 704-8844 or (773) 491-1479

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The provisions of this plan are mandatory for all of the personnel and subcontractors assigned to the project. CEI requires all visitors to any work site to abide by these procedures. Work conditions can change as operations progress. The Health and Safety Officer will provide written addenda to this SHSP when changes warrant. No changes to the plans will be implemented without prior approval of the Health and Safety Officer or his authorized representative.

This SHSP was developed to be consistent with current applicable laws and regulations as of April 1, 1998. If laws or regulations change, this SHSP should be updated to comply.

2.5 References

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(b) *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities* (NIOSH 85-115);
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(d) 35 Illinois Administrative Code 742, *Tiered Approach to Corrective Action Objectives*

3.0 RESPONSIBILITIES

3.1 All Personnel

All personnel are responsible for continuous adherence to these health and safety procedures during the performance of their work. No person may work in a manner that conflicts with the intent of, or the inherent safety and environmental precautions expressed in these procedures. After due warnings, CEI's designated agents will dismiss from the site any person who violates safety procedures. CEI's employees are subject to progressive discipline and may be terminated for continued violations. All on-site personnel will be trained in accordance with both 29 CFR 1910.120, and this document.

3.2 Health and Safety Officer and On-Site Safety Coordinator

The project Health and Safety Officer is responsible for developing and coordinating the SHSP and addenda as required. This plan complies with 29 CFR 1910.120 in all respects and includes medical surveillance and training requirements, hazard assessment, personal protective equipment specifications, field implementation procedures, and audits. The Health and Safety Officer will issue addenda to the SHSP if warranted by changed conditions. The Health and Safety Officer and his designee report to the Project Manager for operational matters. The Health and Safety Officer is the contact for regulatory agencies on matters of safety and health. Other Health and Safety Officer responsibilities include:

- General Health and Safety program administration;

- Determining the level of personnel protection required;
- Updating equipment or procedures based on information obtained during site operations;
- Establishing air monitoring parameters based on expected contaminants;
- Establishing employee exposure monitoring notification programs;
- Investigating significant accidents and illnesses and implementing preventative measures, if necessary;
- Performing regular site inspections; and
- Developing site-specific employee/community emergency response plans, as required, based on expected hazards.

3.3 Project Manager

The Project Manager is ultimately responsible for ensuring that all project activities are completed in accordance with requirements set forth in this SHSP.

3.4 Site Supervisor

The Site Supervisor supervises all activities at the site and is responsible for field implementation of the SHSP. This includes communicating site requirements to all personnel, ensuring field supervisors and subcontractors enforce all provisions of the plan, and consulting with the Health and Safety Officer regarding changes to the SHSP. Other responsibilities include:

- Reading and becoming familiar with this SHSP and CEI's policies and procedures;
- Enforcing the SHSP and other safety regulations;
- Stopping work as required to ensure personal and environmental health and safety;
- Determining evacuation routes, establishing and posting local emergency telephone numbers, and arranging emergency transportation;
- Ensuring that all site personnel and visitors have received the proper training and medical clearance prior to entering the site (See Section 7 of this plan.)
- Establishing Exclusion, Contamination Reduction and Clean Zones (See Section 8 of this plan);
- Presenting tailgate safety meetings and maintaining attendance logs and records;
- Assuring that the respiratory protection program is implemented (See Section 6 of this plan);
- Assuring that decontamination procedures meet established criteria;
- Assuring that there is a person qualified to administer first aid on site;
- Discussing potential health and safety hazards with the Health and Safety Officer; and

- Implementing changes as directed by the Health and Safety Officer and Project Manager.

3.5 Subcontractors

On-site subcontractors and their personnel are responsible for understanding and complying with all site requirements. Subcontractors are required to follow the guidelines established in the SHSP.

3.6 On-Site Personnel and Visitors

All on-site personnel and visitors are required to comply with the provisions of the SHSP and all applicable Federal, State and local regulations. Each person is responsible for their own health and safety, for completing tasks in a safe manner and for reporting any unsafe acts or conditions to his supervisor or CEI's designated representative. Personnel will monitor themselves and their fellow employees for signs and symptoms of heat/cold stress and chemical exposure.

4.0 JOB HAZARD ANALYSIS

4.1 Scope of Work

Specific field activities associated with any subterranean investigations may include emplacing soil borings, soil sampling, constructing ground water monitoring wells, and ground water sampling, as necessary.

4.2 Job Safety Analysis

The Job Safety Analysis identifies potential safety, health, and environmental hazards and provides for the protection of personnel, the community and the environment. Because of the complexity and constant change of this type of project, supervisors must continually inspect the work site to identify hazards which may harm site personnel, the community, or the environment. The Project Manager and Site Supervisor must be aware of these changing conditions and discuss them with the Health and Safety Officer. The Health and Safety Officer will write addenda to change Job Safety Analysis and associated hazard controls as necessary.

4.2.1 Soil Boring and Sampling Activities - Specific field activities associated with any subterranean investigations may include emplacing soil borings, soil sampling, constructing ground water monitoring wells, and ground water sampling, as necessary. Hazards connected with these activities include dangers associated with the operation of heavy machinery (i.e a probing machine or drill rig) and the potential for exposure to unknown contaminants while collecting samples. On-

site personnel will wear steel-toed boots, hard hats, safety glasses and protective sampling gloves to reduce their potential for harm. On-site personnel will also be instructed to be aware of drilling activities, listen for backup alarms and keep a safe distance from the boring while the drill rig is operating.

Either a photoionization detector (PID) or an organic vapor analyzer (OVA) will be used to monitor conditions in the breathing zone during any subterranean investigations. If the ambient air PID/OVA readings in the breathing zone exceed the background level by 5 ppm or more, Level C personal protective equipment (including cartridge respirators) will be worn by all personnel. If the ambient air PID/OVA readings in the breathing zone exceed the background level by 100 ppm or more, Level B personal protective equipment (including supplied air respirators) will be worn. Refer to Section 6.2 for more information on Level C and Level D personal protective equipment.

The following constituents were identified at high enough levels, during previous investigations at the subject site to warrant concern: lead, cadmium and trichloroethene.

4.3 Hazardous and Toxic Materials

Uncommon hazards connected with this project are mostly associated with the potential for exposure to TCE, cadmium, lead, and tantalum. Included in Attachment B are the MSD Sheets for these compounds. These tables will be developed as information becomes available during the project.

4.4 Heat and Cold Stress

Wearing personal protective equipment puts a hazardous waste site worker at considerable risk of heat stress. Heat stress effects range from mild heat fatigue to serious illness and death. Heat stress is caused by several interacting factors, including environmental conditions, clothing, work load, and the individual characteristics of the worker. Because heat stress is the most common and potentially serious illness at hazardous waste sites, preventive measures and alertness to the signs and symptoms are vital.

Heat stress monitoring should begin when personnel are wearing PPE, including Tyvek® coveralls, and the ambient temperature exceeds 21°C (70°F). If impermeable garments are not worn, heat stress monitoring should begin at 29°C (85°F).

4.5 Confined Space Entry

Confined spaces are any enclosed area not designed for human occupancy with limited means of

entry and egress, and insufficient ventilation to ensure that the space has a safe atmosphere. Confined space entries are not anticipated during subterranean investigations. If subsequent phases of investigation or remediation activities require confined space entry, CEI's confined spaced entry and safety procedures will be employed. These procedures should be based on OSHA's Standard on Confined Spaces (*58 Federal Register 4462*).

4.6 Dust Control and Spill Control

During subterranean investigations, contaminated dust could pose a potential hazard, because of this, dust control and suppression may be necessary to protect personnel, the community, and the environment. Depending on the moisture content of the exposed site soils, the application of water may be necessary to control and suppress dust from dry, exposed soil surfaces.

Due to the very low potential for the use of potentially hazardous liquids in this project, the need for spill control is not anticipated.

4.7 Hearing Conservation

All personnel on site will wear hearing protection while operating heavy equipment. If on-site personnel are subjected to noise exceeding an 8-hour, time-weighted average sound level of 90 dBA (decibels on the A-weighted scale), feasible administrative or engineering controls will be utilized. In addition, whenever noise exposure equals or exceeds an 8-hour, time-weighted average sound level of 85 dBA, a hearing conservation program, as described in 29 CFR 1910.95, will be employed.

5.0 SAFETY PROGRAM

The following procedures are mandatory for all of CEI's and subcontractor personnel. All site visitors entering Exclusion Zones must follow these procedures. Personnel not following procedures will be warned. If they refuse to follow these procedures, they will be escorted from the site.

5.1 General Practices

- At least one copy of this plan will be available at the job work site.
- At least one person trained in a minimum of basic first aid and CPR will be on site whenever remediation activities occur. As an alternative, this requirement is satisfied when a 911 emergency responder can respond within five (5) minutes to the site.
- No food, beverages, tobacco products will be present, consumed or used in contaminated

areas or potentially contaminated areas. Taking medication, smoking or applying cosmetics are also prohibited. These activities are allowed only in the established clean room and clean areas.

- Before eating, drinking, or smoking employees will wash their hands and remove chemical-resistant suits (if they are being worn).
- Containers will be moved only with the proper equipment and will be secured to prevent dropping or loss of control during transport.
- Emergency equipment will be located in readily accessible uncontaminated locations. At least one eyewash will be maintained in the Contamination Reduction Zone (CRZ).
- All personnel entering the site will be thoroughly briefed on the hazards, equipment requirements, safety practices, emergency procedures, and communication methods.
- Employee entrance and exit routes will be planned and emergency escape routes designated. A map showing evacuation routes will be posted at the site.
- Unfamiliar operations will be discussed with affected employees before beginning work.
- Operations will be stopped whenever visible dust emissions are generated. Site wetting practices will be used to control dust emissions.
- Work areas will be illuminated to a minimum of 20 foot candles. Supplementary lighting may be necessary inside buildings, tanks, at night, or in other poorly lit areas.
- Unless site activities extend for more than several weeks, no portable sanitary facilities will be provided.
- No smoking will be permitted on the project except in designated areas.
- Fire extinguishers will be mounted on equipment as required. When there is a fire potential, fire extinguishers will be located in the adjacent area.

5.2 Fall Protection

The walking and working surfaces will become wet, muddy and slippery during rain. Use extra caution when working on muddy ground.

5.3 Buddy System

All on-site personnel will use the buddy system. Buddies will maintain visual contact with each other. Personnel must observe each other for signs of heat stress or toxic exposure such as:

1. Changes in complexion and skin discoloration
2. Changes in coordination or demeanor
3. Excessive salivation and pupillary response
4. Changes in speech pattern

Personnel will inform their supervisor of nonvisual effects of toxic exposure such as:

1. Headaches, dizziness, blurred vision
2. Nausea, cramps
3. Irritation of eyes, skin or respiratory tract

5.4 Heat and Cold Stress

Heat stress, due to protective clothing decreasing body ventilation, is an important factor. Heat stress of employees on site will be monitored by the American Red Cross method of monitoring heart rates as personnel come out for rest and cooling off.

One or more of the following control measures can be used to help control heat stress and are mandatory if heat stress is detected by elevated heart rate above 110 beats per minute.

1. Employees should drink plenty of water throughout the day and should increase their salt intake slightly.
2. On-site drinking water will be kept cool, 10-15°C (50-60°F), to encourage personnel to drink often.
3. A work regimen that will provide adequate rest periods for cooling down will be established as required.
4. All personnel will be advised of the dangers and symptoms of heat stroke and exhaustion.
5. Cooling devices such as vortex tubes or cooling vests can be worn beneath protective garments.
6. Employees will be admonished to monitor themselves and their co-workers for the effects of heat disorders and to take additional breaks as needed.
7. All breaks are taken in a shaded rest area.
8. Employees will not do other tasks during rest periods.
9. Employees will remove impermeable garments during rest periods.
10. All employees will be informed of the importance of adequate rest, acclimatization and proper diet in the prevention of heat stress.

5.4.1 Signs And Symptoms Of Heat Stress -

Heat Cramps:

Heat cramps are caused by heavy sweating and inadequate electrolyte replacement. Signs and symptoms include muscle spasms and pain in the hands, feet and abdomen.

Heat Exhaustion:
Heat exhaustion occurs from increased stress on various body organs including inadequate blood circulation due to cardiovascular insufficiency or dehydration. Signs and symptoms include:

- Pale, cool, moist skin
- Heavy sweating
- Dizziness, Nausea
- Fainting

Heat Stroke:
Heat stroke is the most serious form of heat stress. Temperature regulation fails and the body temperature rises to critical levels. Immediate action must be taken to cool the body before serious injury or death occur. Competent medical help must be obtained immediately. This is a true medical emergency. Signs and symptoms are:

- Red, hot, usually dry skin
- Lack of or reduced perspiration
- Nausea
- Dizziness and confusion
- Strong, rapid pulse initially
- Coma

5.4.2 Cold Stress - Most cold-related worker fatalities have resulted from failure to escape low environmental air temperatures, or from immersion in low temperature water. The single most important aspect of life-threatening hypothermia is a fall in the deep core temperature of the body.

Employees should be protected from exposure to cold so that the deep core temperature does not fall below 36°C (98.6°F.) Lower body temperature will very likely result in reduced mental alertness, reduction in rational decision making, or loss of consciousness with the threat of fatal consequences.

- Workers will be provided with warm clothing, such as mittens and heavy socks, when the air temperature is below 4-7°C (40-45°F.) Protective clothing may be used to protect the employee.
- When the air temperature is below 0-7°C (32-40°F) (depending on employee comfort), clothing for warmth, in addition to protective clothing will be provided. This will include:
  1. Insulated suits, such as whole-body thermal underwear;
  2. Wool socks or polypropylene socks to keep moisture off the feet if there is a potential of work activity which would cause sweating;
  3. Insulated gloves;
  4. Boots; and
  5. Insulated head cover, such as knit caps.

- At air temperature below 2°C (35°F) the following work practices must be followed:
  1. If the clothing of an employee might become wet on the job site, the outer layer of the clothing must be impermeable to water.
  2. If an employee's underclothing (socks, mittens, etc.) becomes wet in any way, the employee must change into dry clothing immediately. If the clothing becomes wet from sweating, the employee may finish the task which caused the sweating before changing into dry clothing.
  3. Employees must be provided a warm area, 18°C (65°)F or above, to change from work clothing into street clothing.
  4. Employees must be provided a warm break area, 15°C (60°F) or above.
  5. Hot liquids, such as soups, warm, sweet drinks, will be provided in the break area. The intake of coffee will be limited because of the attendant diuretic and circulatory effects.
  6. The buddy system will be practiced at all times. Any employee observed with severe shivering will leave the cold area immediately.
  7. Employees should layer their clothing. Thinner, lighter clothing should be worn next to the body with heavier clothing layered outside the inner clothing.

8. Avoid overdressing when going into warm areas or when performing activities which are strenuous. This could lead to heat stress problems.
9. Employees handling volatile liquids (such as gasoline, hexane, alcohol) will take special precautions to avoid spilling liquids on clothing or gloves because of the added danger of cold injury by evaporative cooling.

5.5 Hearing Conservation

All on-site personnel will wear hearing protection (E.A.R.® foam inserts or equivalent) when operating earthmoving equipment or whenever noise levels exceed 85 dBA. All personnel required to wear hearing protection will receive baseline and annual audiograms and training on the causes and prevention of hearing loss.

The Health and Safety Officer will evaluate noise hazards with appropriate instrumentation, including an ANSI Type 2 or Type 1 sound level meter and noise dosimeters, if available.

6.0 PERSONAL PROTECTIVE EQUIPMENT

The personal protective equipment (PPE) outlined below have been selected according to the site characterization and analysis, job tasks, site hazards, intended use and duration of potential employee exposures. Maintenance and storage of PPE, decontamination, donning and doffing procedures, inspection and monitoring of effectiveness, and limitation are outlined in this section.

6.1 Respiratory Protection

- Only employees who have been trained to wear and maintain respirators properly will be allowed to use respiratory protection.
- Only properly cleaned, maintained, National Institute of Occupational Safety and Health (NIOSH) approved respirators will be used on site.
- Selection of respirators, as well as any decisions regarding upgrading or downgrading of respiratory protection, will be made by the Health and Safety Officer or his designee.
- Used air-purifying cartridges will be replaced at the end of each shift. Powered air-purifying respirators (PAPR) cartridges will be changed when flow falls below 4 cubic feet per minute (cfm) through the cartridge.
- Positive and negative pressure tests will be performed each time the respirator is donned.
- Only employees who have been fit tested within the last 6 months will be allowed to work in atmospheres where respirators are required. Subcontractors will provide certificates of respirator fit test completed within the last 6 months for each employee on site.

- Respirator users will be instructed in the proper use and limitations of respirators.
- If an employee has difficulty in breathing during the fit test or during use, he will be evaluated medically to determine if he can wear a respirator safely while performing assigned tasks.
- No employee will be assigned to tasks requiring the use of respirators if, based upon the most recent examination, a physician determines that the health or safety of the employee will be impaired by respirator use.
- Contact lenses will not be worn while using any type of respiratory protection.
- Air-supplied respirators will be assembled according to manufacturer's specifications. Hose length, couplings, valves, regulators, manifolds and all accessories will meet ANSI and the manufacturer's requirements.
- Respirators will be cleaned and sanitized daily after use.
- Respirators will be stored in a convenient, clean and sanitary location on site.
- Respirators will be inspected during cleaning. Worn or deteriorated parts will be replaced.
- Facial hair that might interfere with a good face piece seal or proper operation of the respirator is prohibited.
- The Site Supervisor will review the respiratory protection program daily to ensure employees are properly wearing and maintaining their respirators and that the respiratory protection is adequately protecting the employees.
- The Health and Safety Officer and the Project Manager will evaluate the respiratory protection program monthly to ensure the continuing effectiveness.
- Respirators used for emergency response will be inspected weekly by the Health and Safety Officer.

6.2 Levels of Protection

The level of protection used in the Exclusion Zone is based on site-specific information. The levels of protection are outlined as follows. Specific levels of protection will be changed whenever site conditions change. They can either be increased to the next higher level or decreased to the next lower level. The decision to change levels of protection will be made by the Site Supervisor with input from the Project Manager and the Health and Safety Officer. If the need arises to protect health and safety, the Site Supervisor can upgrade protection levels without input from the Health and Safety Officer or Project Manager. He will then discuss the decision with the Health and Safety Officer, Health and Safety Coordinator, and the Project Manager when they are available. Levels of protection will not be downgraded without prior approval from the Health and Safety Officer.

6.2.1 Level A Protection - Level A Protection is not anticipated for this project.

6.2.2 Level B Protection - Level B Protection is also not anticipated for this project. Level B Protection will be required if airborne concentrations of toxic contaminants exceed twice the permissible exposure level as determined by personnel monitoring. The Health and Safety Officer will be notified when the decision is made to upgrade to Level B.

The following equipment will be used for Level B Protection:

- Pressure-demand, full-facepiece self-contained breathing apparatus (SCBA) or pressure demand supplied air respirator with escape SCBA;
- Hooded one piece chemical-resistant suit (double-layered), Tyvek® or equivalent, taped at gloves and boot covers;
- Inner and outer chemical resistant gloves including neoprene, nitrile or other impermeable material;
- Steel-toed boots with chemical resistant disposal boot covers;
- Hardhat; and
- Two-way radio communications.

6.2.3 Level C Protection - Level C Protection is not anticipated for this project. Level C will be required if concentration of toxic airborne contaminants exceed one-half the OSHA permissible exposure limit (PEL).

The following equipment will be used for Level C Protection:

- Half mask or full-facepiece air-purifying respirators with combination organic vapor/HEPA filter (color-coded black and magenta or black and purple.)
- Hooded one piece chemical-resistant suit (double-layered), Tyvek® or equivalent, taped at gloves and boot covers;
- Inner and outer chemical resistant gloves including neoprene, nitrile or other impermeable material (If leather or canvas outer gloves are used, they will be disposed at the end of each shift);
- Steel-toed boots with chemical resistant disposal boot covers;
- Hardhat;
- Safety glasses (when using half mask respirators); and
- Two-way radio communication.

6.2.4 Level D Protection - Level D Protection will be used if concentration of toxic airborne contaminants does not exceed one-half the PEL. Site personnel will ensure that there is no potential for exposure to toxic vapors or dusts.

The following equipment will be used for Level D Protection:

- Coveralls or work clothes;
- Steel-toed boots/shoes;
- Safety glasses;
- Hardhat; and
- Gloves as necessary

Whenever dermal contact with PCB-contaminated soil will occur, site workers will wear PCB-resistant gloves (i.e. Silver Shield™, or equivalent).

6.3 Donning and Doffing

All persons entering the Exclusion Zone will put on the required PPE according to established procedures in this plan to minimize exposure potential. When leaving the Exclusion Zone, PPE will be removed according to these established procedures to minimize the spread of contamination.

6.3.1 Donning Procedures -

- Inspect the clothing and respiratory equipment before donning.
- Remove any outer layers of street clothing that will not be worn beneath PPE, and store in a clean location.
- Put on coveralls, work clothes and hooded suit as necessary.
- Put on boots and boot covers as required.
- Put on air tanks and harness assembly of the SCBA. Don and adjust the facepiece.
- Perform negative and positive respirator facepiece seal test procedures.
- Put on inner and outer gloves as necessary.
- Put on remaining protective equipment, such as hard hat, safety glasses, etc.

6.3.2 Doffing Procedures - Whenever a person leaves the work site, the following proper decontamination sequence will be followed:

- Upon entering the Contamination Reduction Zone, rinse contaminated mud and debris from boots.
- Clean reusable protective equipment.
- Remove any extraneous or disposable clothing, boot covers, gloves and tape.
- Remove boots and gloves.
- Wash hands and face thoroughly.

- Clean respirator and prepare for next use.

All disposable equipment, garments, and PPE will be bagged in two 6 mil plastic bags, properly labeled and disposed.

6.4 Sanitation

No portable sanitary facilities will be provided. Restrooms are available for use in the Fansteel facility.

Workers at the site will keep the work and support areas neat and orderly and collect and properly dispose of all trash generated by their activities.

7.0 SITE CONTROL

Site control requires establishing specific measures to prevent unauthorized entry onto the site and to protect all personnel entering the site from recognized safety and health hazards. The following measures are mandatory:

7.1 Authorization to Enter

The Project Manager and the Site Supervisor may grant authorization to enter the site. Access to contaminated work areas is regulated and limited to authorized personnel. Only those who have completed the required training and medical requirements will be allowed to enter. Representatives from regulatory agencies personnel will be permitted to enter the site at any time during business hours or at other reasonable times by appointment to conduct official business. Representatives of the news media and other visitors must receive authorization from the Project Manager before entry.

7.2 Hazard Briefing

The Site Supervisor will brief this SHSP to all personnel entering the site to inform them of potential health and safety hazards and procedures specific to this site. All personnel will acknowledge this briefing by signing the SHSP. This briefing will be further documented in the daily log.

7.3 Documentation of Certification

Personnel entering the site to work must have satisfied the medical and training requirements of 29 CFR 1910.120. The project file will contain copies of certificates documenting status for all on-site

personnel. The Site Supervisor will accommodate requests from representatives from regulatory agencies to visit the site or review training documentation. All visitors must present documentation of current training and medical status before being granted authorization to enter the Exclusion Zone.

7.4 Entry Log

The Site Supervisor keeps a daily roster of all on-site personnel. The Site Supervisor records the time of entry into and exit from the Exclusion Zone for each person.

7.5 Entry Requirements

All personnel entering work or Exclusion Zones will use the proper PPE. All personnel entering Exclusion Zones will enter and exit through the decontamination units and observe the mandatory decontamination procedures.

7.6 Emergency Entry and Exit

During emergencies, decontamination will be conducted to the extent that is possible without endangering personnel. All persons responding, both on-site and off site, will be informed of site safety and health hazards and health hazards associated with contaminated personnel.

8.0 DECONTAMINATION

8.1 Contamination Control Zones

The Project Manager will establish contamination control zones for the project based on the location of contamination, remediation activities, accessibility, and site control. During remediation activities, these zones must be clearly marked and defended against unauthorized entry.

8.1.1 Exclusion Zone - An Exclusion Zone is the area where contamination does or could occur. This zone has the highest potential for exposure to the contaminants by contact or inhalation.

8.1.2 Contamination Reduction Zone - The CRZ is established at the entry and exit to the Exclusion Zone. Decontamination activities take place in the CRZ.

8.1.3 Support Zone - Support zones are established in uncontaminated areas and are used for the storage of supplies and general administrative functions.

8.2 Posting

During extended projects, where there is a risk of unauthorized entry, the perimeter fence will be posted with "keep out" signs. Warning tape will be posted to delineate the Exclusion Zone.

8.3 Decontamination General Rules

- An area outside of the Exclusion Zone will be designated as the break area. Employees will proceed through personal decontamination before eating, drinking or smoking. No eating, drinking or smoking will take place in the Exclusion Zone.
- The Site Supervisor will monitor the effectiveness of the decontamination procedures and if ineffective will take appropriate steps to correct any deficiencies or modify the plan as needed.

8.4 Equipment Decontamination

The purpose of the Contamination Reduction Zone is to limit the spread of contamination by contaminated personnel, tools, equipment and materials from the Exclusion Zone. Any person, tool, equipment or material from inside the Exclusion Zone will be considered contaminated and must be cleaned before leaving the work site. Refer to Section 4.4 of the *Site Investigation Work Plan* for additional information regarding equipment decontamination.

8.5 Personal Protective Equipment Decontamination

Whenever a person leaves the work site, the following proper decontamination sequence will be followed:

- Rinse contaminated mud, etc. from boots or remove boot covers.
- Remove protective garments and equipment and respirator. All disposable clothing should placed in plastic bags and disposed of properly.
- Reusable protective equipment must either be cleaned on site or bagged and returned to stockroom with appropriate warning labels.
- Remove respirator after contaminated outer wear has been removed.
- Thoroughly wash hands and face.
- Clean respirator and prepare for next use.

All disposable equipment, garments, and PPE (including sampling gloves, tyvek, and filter cartridges) will be placed in 55-gallon steel drums. The drums will be properly disposed of in accordance with applicable rules and regulations.

All contaminated reusable equipment, garments, and PPE which is not cleaned on site will be bagged in two 6 mil plastic bags, properly labeled and returned to the stockroom for decontamination prior to storage.

9.0 SITE MONITORING

9.1 Air Monitoring

Air in the breathing zone will be monitored whenever odor indicates the presence of airborne contaminants. When PID or OVA readings in the breathing zone exceed the background level by 5 ppm or more, level of protection will be upgraded from Level D to Level C and the Health and Safety Officer notified.

9.2 Hazardous Conditions

The Site Supervisor will take affirmative action to limit exposures. If unknown chemicals or contamination are encountered, operations will cease until the situation is evaluated. The Site Supervisor will contact the Health and Safety Officer to evaluate any potentially hazardous situations, or any situation with elevated contamination levels. Operations will only be resumed if they can be accomplished in a safe manner.

9.3 Noise Monitoring

Noise monitoring will be conducted as required. Hearing protection is mandatory for all employees in areas around noise hazards and/or while operating heavy equipment. On-site personnel must wear monitoring equipment as instructed by the health and safety representative. Refusal to wear monitoring equipment or intentional tampering with sampling apparatus will lead to immediate dismissal from the job site.

9.4 Monitoring and Record Keeping

The Health and Safety Officer or his designee will be responsible for establishing and maintaining records of all required monitoring as described below:

- Employee name and social security number;
- The date, time, pertinent task information, exposure information;
- Description of the analytical methods, equipment used, calibration data;
- Type of PPE worn;
- Engineering controls used to reduce exposure.

10.0 EMPLOYEE TRAINING

10.1 General

All field personnel must be trained according to 29 CFR 1910.120 before their initial assignment to any project. All field employees receive a minimum of 40 hours of training off site and a minimum of 3 days of actual field experience under the direct supervision of a trained, experienced supervisor. Subcontractor personnel must meet the above training requirements. Personnel, including subcontractors, whose activities are limited to nonhazardous activities must complete 24 hours of training off site and 8 hours of on-site training. Asbestos workers receive 40 hours of classroom training for asbestos work.

On-site management and supervision receive a minimum of 8 hours of additional training on program supervision. Each hazardous waste operations employee receives 8 hours annually of refresher training on the topics listed in the course content.

10.2 Site Workers Course Content

Following is a general list of topics covered in the 40-hour course:

- General site safety
- Physical hazards (fall protection, noise, heat stress, cold stress)
- Names and titles of key personnel responsible for site health and safety
- Safety, health and other hazards present at the site
- Use of PPE
- Work practices by which employees can minimize risks from hazards
- Safe use of engineering controls and equipment on site
- Medical surveillance requirements including recognition of symptoms and signs which might indicate over exposure to hazards
- Worker Right-to-Know
- Routes of exposure to on-site contaminants
- Engineering controls and safe work practices

- Components of the site health and safety program
- Decontamination practices for personnel and equipment
- Confined space entry procedures
- Emergency response plan

10.3 Supervisors Course Content

Management and supervisors receive an additional 8 hours of training which includes:

- General safety and health program
- Personal protective equipment program
- Spill containment program
- Air monitoring techniques

10.4 Asbestos Workers Course Content

Following is a general list of topics covered in the 40-hour course:

- Methods of recognizing asbestos and asbestos-containing materials
- Health effects associated with asbestos, the relationship between asbestos exposure and lung cancer
- Operations which may lead to asbestos exposure
- Exposure mitigation practices and procedures
- Engineering and work practice controls for minimizing exposures
- Respiratory protection
- Housekeeping procedures
- Hygiene facilities and procedures
- Protective clothing
- Decontamination procedures
- Emergency procedures
- Waste disposal procedures
- Medical surveillance program
- OSHA asbestos standard

10.5 Pre-Entry Briefings

The following training sessions and informational materials are provided at each project site:

10.5.1 Tailgate Safety Meetings - The Site Supervisor conducts a tailgate safety meeting the beginning of each shift or whenever new employees arrive at the job site once the job commences. The topics discussed at the tailgate safety meeting include health and safety considerations for the day's activities, necessary protective equipment, problems encountered, and new operations. Attendance records and meeting notes are maintained with the project files.

10.5.2 Material Safety Data Sheets - The following constituents of concern were identified at elevated concentrations: TCE, lead, cadmium, and tantalum. The Material Safety Data Sheets (MSD Sheets) for each of these chemicals can be found in Attachment B.

10.5.3 Health and Safety Plans - CEI will have a site-specific health and safety plan prepared for each project falling within the scope and application of 29 CFR 1910.120. Injury and illness prevention programs are written for all other projects. The Site Supervisor presents the health and safety plan and discusses it with everybody assigned to the project. All workers and visitors must read and sign the health and safety plan acknowledging acceptance of site rules and understanding of site hazards before entering.

11.0 MEDICAL SURVEILLANCE

11.1 Physical Examination

All personnel on site will have successfully completed a pre-placement or periodic/update physical examination. This examination has been designed to meet the requirements of 29 CFR 1910.120 requirements for hazardous waste site operations and 29 CFR 1926.58 requirements for asbestos operations.

CEI's medical surveillance program examination consists of:

- Medical and occupational history questionnaire
- Physical examination
- Complete blood count with differential
- SMAC 24
- Urinalysis
- Chest x-ray
- Pulmonary function test
- Audiogram
- Visual acuity

The following information is provided to the examining physician:

- Description of employee's duties
- Anticipated chemical and asbestos exposure and levels
- Description of the PPE to be used
- Information from previous medical exams

A copy of the medical examination is provided at the employee's request. The employee will be informed of any medical conditions that would result in work restriction or that would prevent them from working at hazardous waste sites.

Contractors will certify that all their employees have successfully completed a physical examination by a qualified physician on the Certification Form (Attachment C). The physical examinations will meet the requirements of 29 CFR 1910.120, and 29 CFR 1910.134.

Contractors will supply copies of the medical examination certificate for each on-site employee.

11.2 Medical Records

Medical and personal exposure monitoring records will be maintained according to the requirements of 29 CFR 1910.20 and will be kept for a minimum of 30 years. Employee confidentiality will be maintained.

12.0 EMERGENCY PROCEDURES

The SHSP has been developed to allow remediation activities and operations to be conducted without adverse impacts on the health and safety of the worker, environment and community. Supplementary emergency response procedures are included to cover extraordinary conditions that might occur at various sites.

12.1 General

The Site Supervisor and Health and Safety Coordinator will establish evacuation routes and assembly areas for each site. All personnel entering the site will be informed of these routes and assembly areas. If the site is large and the evacuation routes are not clear, a site plan will be made marking the evacuation routes and will be posted at conspicuous locations.

Each site will be evaluated for the potential for fire, explosion, chemical release or other catastrophic events. Based on site characterization and remediation activities, chemical releases and explosions are not likely to occur. Unusual events, activities, chemicals and conditions will be reported to the Site Supervisor.

12.2 Emergency Response

All incidents will be dealt with in a manner to minimize adverse health risks to site workers, the environment and the local community. If an incident occurs the following procedure will be followed:

> The Site Supervisor will act as the site emergency coordinator and will evaluate each incident to determine the extent of the incident and the need for outside assistance. Outside assistance will be requested as needed. The emergency coordinator will act as liaison between responding agencies and site personnel. The emergency coordinator will notify the Project Manager and Health and Safety Officer of any incident, maintain appropriate records and report incidents.

The emergency coordinator has the authority to commit resources as needed to contain and control released material and to prevent its spread to off site areas.

12.3 Safety Signals

Vehicle, tractor, or portable horns will be used for safety signals as follows:

1 Long Blast:	Emergency evacuation
2 Short Blasts:	Clear working area around powered or moving equipment

12.4 Medical Emergencies

Paramedics will be summoned without delay in the event of a medical emergency. The emergency coordinator will stay on the line with the 911 operator until the 911 operator hangs up.

12.5 Reporting Injuries and Illnesses

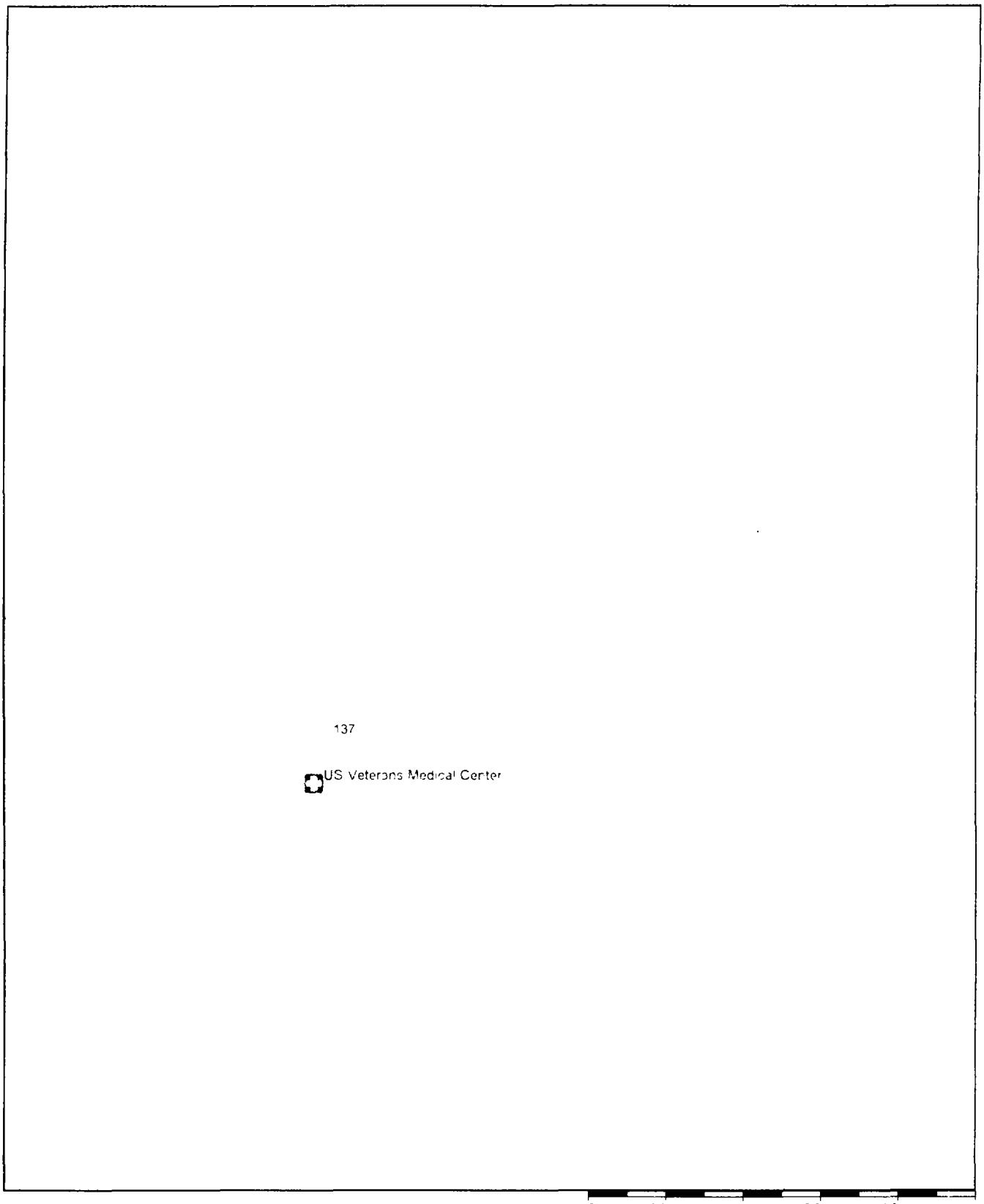
Employees will report all injuries to their supervisor immediately and illnesses as soon as the employee knows he is sick. Supervisors will complete a report of injury within 24 hours of the occurrence. The report of injury will be kept in the project file.

ENVIRONMENTAL INC.

ATTACHMENT A

SITE AND HOSPITAL LOCATION MAP

Map



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ENVIRONMENTAL, INC.

ATTACHMENT B

CHEMICAL INFORMATION

Genium Publishing Corporation
1145 Catalyn Street
Schenectady, NY 12303-1836 USA
(518) 377-8854

Material Safety Data Sheets Collection:

Sheet No. 713
Lead (Inorganic)

Issued: 8/90

Section 1. Material Identification

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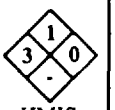
Lead (Inorganic) (Pb) Description: Exists widely throughout the world in a number of ores. Its main commercial source is galena (lead sulphide). Lead mineral is separated from crude ores by blast-furnace smelting, drossing, or electrolytic refining. Lead is used mostly in manufacturing storage batteries. Other uses are in manufacturing tetraethyllead and both organic and inorganic lead compounds in ceramics, plastics, and electronic devices; in producing ammunition, solder, cable covering, sheet lead, and other metal products (brass, pipes, caulking); in metallurgy; in weights and as ballast; as a chemical intermediate for lead alkyls and pigments; as a constuction material for the tank linings, piping, and equipment used to handle the corrosive gases and liquids used in sulfuric acid manufacturing, petroleum refining, halogenation, sulfonation, extraction, and condensation; and for x-ray and atomic radiation protection.
Other Designations: CAS No. 7439-92-1, lead oxide; lead salts, inorganic; metallic lead; plumbum.
Manufacturer: Contact your supplier or distributor. Consult the latest *Chemicalweek Buyers' Guide*(73) for a suppliers list.

R	0
I	4
S	-
K	0

Genium



HMIS
H 3
F 1
R 0
PPG*

* Sec. 8

Cautions: *Inorganic lead is a potent systemic poison.* Organic lead (for example, tetraethyl lead) has severe, but different, health effects. Occupational lead poisoning is due to inhalation of dust and fumes. Major affected organ systems are the nervous, blood, and reproductive systems, and kidneys. Health impairment or disease may result from a severe acute short- or long-term exposure.

Section 2. Ingredients and Occupational Exposure Limits

Lead (inorganic) fumes and dusts, as Pb, ca 100%

1989 OSHA PELs (Lead, inorganic compounds)
8-hr TWA: 50 µg/m³
Action Level TWA*: 30 µg/m³

29 CFR 1910.1025 Lead Standard
Blood Lead Level: 40 µg/100 g

1989-90 ACGIH TLV (Lead, inorganic, fumes and dusts)
TLV-TWA: 150 µg/m³

1988 NIOSH REL
10-hr TWA: <100 µg/m³

1985-86 Toxicity Data†
Human, inhalation, TC_{Lo}: 10 µg/m³ affects gastrointestinal tract and liver
Human, oral, TD_{Lo}: 450 mg/kg ingested over 6 yr affects peripheral and central nervous systems
Rat, oral, TD_{Lo}: 790 mg/kg affects multigeneration reproduction

* Action level applies to employee exposure without regard to respirator use.
† See NIOSH, *RTECS* (OF7525000), for additional mutative, reproductive, and toxicity data.

Section 3. Physical Data

Boiling Point: 3164 °F (1740 °C)
Melting Point: 621.3 °F (327.4 °C)
Vapor Pressure: 1.77 mm Hg at 1832 °F (1000 °C)
Viscosity: 3.2 cp at 621.3 °F (327.4 °C)
Molecular Weight: 207.20
Specific Gravity (20 °C/4 °C): 11.34
Water Solubility: Relatively insoluble in hot or cold water*

Appearance and Odor: Bluish-white, silvery, gray, very soft metal.

* Lead dissolves more easily at a low pH.

Section 4. Fire and Explosion Data

Flash Point: None reported	**Autoignition Temperature:** None reported	**LEL:** None reported	**UEL:** None reported

Extinguishing Media: Use dry chemical, carbon dioxide, water spray, or foam to extinguish fire.
Unusual Fire or Explosion Hazards: Flammable and moderately explosive in the form of dust when exposed to heat or flame.
Special Fire-fighting Procedures: Isolate hazard area and deny entry. Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode and full protective equipment. Be aware of runoff from fire control methods. Do not release to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Lead is stable at room temperature in closed containers under normal storage and handling conditions. It tarnishes on exposure to air. Hazardous polymerization cannot occur.
Chemical Incompatibilities: Mixtures of hydrogen peroxide + trioxane explode on contact with lead. Lead is incompatible with sodium azide, zirconium, disodium acetylide, and oxidants. A violent reaction on ignition may occur with concentrated hydrogen peroxide, chlorine trifluoride, sodium acetylide (with powdered lead), ammonium nitrate (below 200 °C with powdered lead). Lead is attacked by pure water and weak organic acids in the presence of oxygen. Lead is resistant to tap water, hydrofluoric acid, brine, and solvents.
Conditions to Avoid: Rubber gloves containing lead may ignite in nitric acid.
Hazardous Products of Decomposition: Thermal oxidative decomposition of lead can produce highly toxic fumes of lead.

Section 6. Health Hazard Data

Carcinogenicity: Although the NTP and OSHA do not list lead as a carcinogen, the IARC lists it as probably carcinogenic to humans, but having (usually) no human evidence. However, the literature reports instances of lead-induced neoplasms, both benign and malignant, of the kidney and other organs in laboratory rodents. Excessive exposure to lead has resulted in neurologic disorders in infants. Experimental studies show lead has reproductive and teratogenic effects in laboratory animals. Human male and female reproductive effects are also documented.
Summary of Risks: Lead is a potent, systemic poison that affect a variety of organ systems, including the nervous system, kidneys, reproductive system, blood formation, and gastrointestinal (GI) system. The most important way lead enters the body is through inhalation, but it can also be ingested when lead dust or unwashed hands contaminate food, drink, or cigarettes. Much of ingested lead passes through feces without absorption into the body. Adults may absorb only 5 to 15% of ingested lead; children may absorb a much larger fraction. Once in the body, lead enters the bloodstream and circulates to various organs. Lead concentrates and remains in bone for many years. The amount of lead the body stores increases as exposure continues, with possibly cumulative effects. Depending on the dose entering the body, lead can be deadly within several days or affect health after many years. Very high doses can cause brain damage (encephalopathy).
Medical Conditions Aggravated by Exposure: Lead may aggravate nervous system disorders (e.g., epilepsy, neuropathies), kidney diseases, high blood pressure (hypertension), infertility, and anemia. Lead-induced anemia and its effect on blood presssure can aggravate cardiovascular disease.

Continue on next page

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Section 6. Health Hazard Data, *continued*

Target Organs: Blood, central and peripheral nervous systems, kidneys, and gastrointestinal (GI) tract.
Primary Entry Routes: Inhalation, ingestion.
Acute Effects: An acute, short-term dose of lead could cause acute encephalopathy with seizures, coma, and death. However, short-term exposures of this magnitude are rare. Reversible kidney damage can occur from acute exposure, as well as anemia.
Chronic Effects: Symptoms of chronic long-term overexposure include appetite loss, nausea, metallic taste in the mouth, lead line on gingival (gum) tissue, constipation, anxiety, anemia, pallor of the face and the eye grounds, excessive tiredness, weakness, insomnia, headache, nervous irritability, fine tremors, numbness, muscle and joint pain, and colic accompanied by severe abdominal pain. Paralysis of wrist and, less often, ankle extensor muscles may occur after years of increased lead absorption. Kidney disease may also result from chronic overexposure, but few, if any, symptoms appear until severe kidney damage has occurred. Reproductive damage is characterized by decreased sex drive, impotence, and sterility in men; and decreased fertility, abnormal menstrual cycles, and miscarriages in women. Unborn children may suffer neurologic damage or developmental problems due to excessive lead exposure in pregnant women. Lead poisoning's severest result is encephalopathy manifested by severe headache, convulsions, coma, delirium, and possibly death.
FIRST AID
Eyes: Gently lift the eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately.
Skin: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Consult a physician if any health complaints develop.
Inhalation: Remove exposed person to fresh air and support breathing as needed. Consult a physician.
Ingestion: Never give anything by mouth to an unconscious or convulsing person. If large amounts of lead were ingested, induce vomiting with Ipecac syrup. Consult a physician immediately.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Physician's Note: For diagnosis, obtain blood pressure, blood lead level (PbB), zinc protoporphyrin (ZPP), complete blood count for microcytic anemia and basophilic stippling, urinalysis, and blood urea nitrogen (BUN) of creatinine. Examine peripheral motor neuropathy, pallor, and gingival lead line. Use Ca-EDTA to treat poison, but *never* chelate prophylactically. Consult an occupational physician or toxicologist.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel and evacuate all unnecessary personnel immediately. Cleanup personnel should protect against inhalation of dusts or fume and contact with skin or eyes. Avoid creating dusty conditions. Water sprays may be used in large quantities to prevent the formation of dust. Cleanup methods such as vacuuming (with an appropriate filter) or wet mopping minimizes dust dispersion. Scoop the spilled material into closed containers for disposal or reclamation. Follow applicable OSHA regulations (29 CFR 1910.120).
Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.
EPA Designations
Listed as a RCRA Hazardous Waste (40 CFR 261.33, Appendix II—EP Toxicity Test Procedures)
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4), Reportable Quantity (RQ): 1 lb (0.454 kg) [* per Clean Water Act, Sec. 307(a)]
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
Listed as a SARA Toxic Chemical (40 CFR 372.65)
OSHA Designations
Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133).
Respirator: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH-approved respirator. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.*
Other: Wear impervious gloves, boots, aprons, and gauntlets to prevent skin contact. Protective clothing made of man-made fibers and lacking turn-ups, pleats, or pockets retain less dust from lead.
Ventilation: Provide general and local ventilation systems to maintain airborne concentrations below the OSHA PELs (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.[109]
Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.
Contaminated Equipment: Never wear contact lenses in the work area: soft lenses may absorb, and all lenses concentrate, irritants. Remove this material from your shoes and equipment. Launder contaminated clothing before wearing.
Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially washing hands before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store in tightly closed containers in a cool, dry, well-ventilated area away from all incompatible materials, direct sunlight, and heat and ignition sources.
Engineering Controls: Educate worker about lead's hazards. Follow and inform employees of the lead standard (29 CFR 1910.1025). Avoid inhalation of lead dust and fumes and ingestion of lead. Use only with appropriate personal protective gear and adequate ventilation. Institute a respiratory protection program that includes regular training, maintenance, inspection, and evaluation. Avoid creating dusty conditions. Segregate and launder contaminated clothing. Take precautions to protect laundry personnel. Practice good personal hygiene and housekeeping procedures. For a variety of reasons, the lead concentration in workroom air may not correlate with the blood lead levels in individuals.
Other Precautions: Provide preplacement and periodic medical examinations which emphasize blood, nervous system, gastrointestinal tract, and kidneys, including a complete blood count and urinalysis. Receive a complete history including previous surgeries and hospitalization, allergies, smoking history, alcohol consumption, proprietary drug intake, and occupational and nonoccupational lead exposure. Maintain records for medical surveillance, airborne exposure monitoring, employee complaints, and physician's written opinions for at least 40 years or duration of employment plus 20 years. Measurement of blood lead level (PbB) and zinc protoporphyrin (ZPP) are useful indicators of your body's lead absorption level. Maintain worker PbBs at or below 40 µg/100 g of whole blood. To minimize adverse reproductive health effects to parents and developing fetus, maintain the PbBs of workers intending to have children below 30 µg/100 g. Elevated PbBs increase your risk of disease, and the longer you have elevated PbBs, the greater your chance of substantial permanent damage.

Transportation Data (49 CFR 172.102)
IMO Shipping Name: Lead compounds, soluble, n.o.s.
IMO Hazard Class: 6.1
ID No.: UN2291
IMO Label: St. Andrews Cross (X, Stow away from foodstuffs)
IMDG Packaging Group: III

***MSDS Collection* References:** 26, 38, 73, 84, 85, 88, 89, 90, 100, 101, 103, 109, 124, 126, 132, 133, 134, 136, 138, 139, 142, 143
Prepared by: MJ Allison, BS; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** MJ Upfal, MD, MPH; **Edited by:** JR Stuart, MS

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Material Safety Data Sheet

From Genium's Reference Collection

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GENIUM PUBLISHING CORP.

No. 312
TRICHLOROETHYLENE
(Revision E)

Issued: July 1979
Revised: August 1987

SECTION 1. MATERIAL IDENTIFICATION

23

MATERIAL NAME: TRICHLOROETHYLENE

DESCRIPTION (Origin/Uses): Prepared from *sym*-tetrachloroethane by way of eliminating HCl by boiling with lime. Used to manufacture organic chemicals, pharmaceuticals; in degreasing and dry cleaning; and as a solvent for fats, waxes, rubbers, oils, paints, varnishes, ethers, and cellulose esters.

OTHER DESIGNATIONS: Ethylene Trichloride; TCE; Trichloroethene; 1,1,2-Trichloroethylene; C_2HCl_3; NIOSH *RTECS* #KX4550000; CAS #0079-01-6

MANUFACTURER/SUPPLIER: Available from several suppliers, including: Dow Chemical USA, 2020 Dow Center, Midland, MI 48640; Telephone: (517) 636-1000; (800) 258-CHEM

COMMENTS: Trichloroethylene is a toxic solvent and a suspected occupational carcinogen.

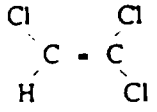
HMIS

H	2	R	1
F	1	I	3
R	1	S	1
PPE*		K	0

* See sect. 8

SECTION 2. INGREDIENTS AND HAZARDS

	%	HAZARD DATA
Trichloroethylene, CAS #0079-01-6; NIOSH *RTECS* #KX4550000	100	ACGIH Values 1987-88



TLV-TWA*: 50 ppm, 270 mg/m^3
TLV-STEL**: 200 ppm, 1080 mg/m^3
OSHA PEL 1986***
8-Hr TWA: 100 ppm
Ceiling: 200 ppm
NIOSH REL 1986
10-Hr TWA: 25 ppm
TOXICITY DATA
Human, Oral, LD_{Lo}: 7 g/kg
Human, Inhalation, TC_{Lo}: 6900 mg/m^3 (10 Min)
Human, Inhalation, TC_{Lo}: 160 ppm/ 83 Min
Human, Inhalation, TD_{Lo}: 812 mg/kg

* The TLV-TWA is set to control subjective complaints such as headache, fatigue, and irritability.

** The TLV-STEL is set to prevent incoordination and other beginning anesthetic effects from TCE. These levels should provide a wide margin of safety in preventing liver injury.

*** The OSHA PEL is 300 ppm for 5 minutes in any 2 hours.

SECTION 3. PHYSICAL DATA

Boiling Point ... 188.6°F (87°C)
Vapor Pressure ... 58 Torr at 68°F (20°C)
Water Solubility ... Insoluble
Vapor Density (Air = 1) ... 4.53
Evaporation Rate ... Not Listed
Specific Gravity ... 1.4649 at 68°F (20°C)
Melting Point ... -120.64°F (-84.8°C)
Molecular Weight ... 131.40 Grams/Mole

Appearance and odor: Colorless, nonflammable mobile liquid; sweetish odor like chloroform.

COMMENTS: TCE is highly soluble in lipids. A high vapor pressure at room temperature provides the potential for TCE vapors to contaminate use areas.

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temperature	Flammability Limits in Air	LOWER	UPPER
		% by Volume		
Not Listed	770°F (410°C)		8%	10.5%

EXTINGUISHING MEDIA: TCE has no flash point in a conventional closed tester at room temperature, but it is moderately flammable at higher temperatures. Use dry chemical, carbon dioxide, alcohol foam, or other extinguishing agents suitable for the surrounding fire.

OSHA Flammability Class (29 CFR 1910.106): Not Regulated

UNUSUAL FIRE/EXPLOSION HAZARDS: During fire conditions TCE emits highly toxic and irritating fumes, including hydrochloric acid and phosgene. SPECIAL FIRE-FIGHTING PROCEDURES: Wear a self-contained breathing apparatus with a full facepiece operated in a pressure-demand or another positive-pressure mode. At TCE vapor levels of 300-1000 ppm, fire fighters who lack the proper respiratory equipment may experience incoordination and impaired judgment.

DOT Flammability Class (49 CFR 173.115): Not Regulated

SECTION 5. REACTIVITY DATA

Trichloroethylene is stable. Hazardous polymerization can occur under certain circumstances (see Conditions to Avoid and Comments, below).

CHEMICAL INCOMPATIBILITIES include magnesium or aluminum powder, NaOH, KOH, or other strong alkaline materials. Reactions with alkaline materials may lead to the formation of dangerous explosive mixtures of chloroacetylenes.

CONDITIONS TO AVOID: When TCE is heated (as in the case with vapor degreasers) or exposed to sunlight, it requires extra stabilization against oxidation, degradation, and polymerization. It is slowly decomposed by light when moist.

PRODUCTS OF HAZARDOUS DECOMPOSITION include hydrochloric acid and phosgene under certain conditions at elevated temperatures.

COMMENTS: TCE is stable under normal handling and storage conditions, and hazardous polymerization is not expected to occur. However, failure of the stabilizer at elevated temperatures or other extreme conditions may allow polymerization to take place..

SECTION 6. HEALTH HAZARD INFORMATION

Trichloroethylene is listed as a carcinogen by the NTP, IARC, and OSHA. NIOSH recommends that trichloroethylene be treated as an occupational carcinogen. IARC carcinogenic results are animal suspect, animal positive, and human indefinite. SUMMARY OF RISKS: Moderate exposures to TCE cause symptoms similar to those of alcohol inebriation. Higher concentrations cause narcotic effects. Ventricular fibrillation has been cited as the cause of death following heavy exposures. TCE-induced hepatocellular carcinomas have been detected in mice during tests conducted by the National Cancer Institute (*Chem & Eng News* 54 [April 5, 1976]:4). Organ systems affected by overexposure to TCE are the central nervous system (euphoria, analgesia, anesthesia), degeneration of the liver and kidneys, the lungs (tachypnea), heart (arrhythmia) and skin (irritation, vesication, and paralysis of fingers when immersed in liquid TCE). Contact with the liquid defats the skin, causing topical dermatitis. Certain people appear to experience synergistic effects from TCE exposure concomitant with exposure to caffeine, alcohol, and other drugs. When combined with alcohol intake, toxic effects are increased and may cause a red, blotchy facial and upper body rash commonly called "degreaser's flush." Other reported symptoms of TCE exposure include abnormal fatigue, headache, irritability, gastric disturbances, and intolerance to alcohol. Toxic effects from ingestion of TCE on humans include hallucination, distorted perception, somnolence (general depressed activity), and jaundice. TARGET ORGANS: Respiratory system, central nervous system, heart, liver, kidneys, and skin. PRIMARY ENTRY: Ingestion, inhalation, skin contact. ACUTE EFFECTS: Headache, vertigo, visual disturbance, tremors, nausea, vomiting, dermatitis, dizziness, drowsiness, and irritation to the eyes, nose, and throat. CHRONIC EFFECTS: None Reported. MEDICAL CONDITIONS AGGRAVATED BY LONG-TERM EXPOSURE: Diseases of the liver, kidneys, lungs, and central nervous system. FIRST AID: EYE CONTACT: Immediately flush eyes, including under the eyelids, gently but thoroughly with plenty of running water for at least 15 minutes. Get medical help.* SKIN CONTACT: Wash thoroughly with soap and water. Remove and launder contaminated clothing before wearing it again; clean material from shoes and equipment. Get medical help.* INHALATION: Remove victim to fresh air; restore and/or support his breathing as needed. Do not give adrenalin to the victim. Get medical help.* INGESTION: Call a poison control center. Never give anything by mouth to someone who is unconscious or convulsing. A professional decision regarding whether or not to induce vomiting is required. Do not give adrenalin to the victim. Get medical help.*

*GET MEDICAL ASSISTANCE - IN PLANT, PARAMEDIC, COMMUNITY. Get prompt medical assistance for further treatment, observation, and support after first aid.

COMMENTS: Workers' responses to TCE vary significantly because of many factors, including age, health status, nutrition, and intake of alcohol, caffeine, and medicines. Do not use these substances before, during, or after exposure to TCE. If a worker displays any of the symptoms of exposure to TCE, thoroughly investigate all the possible contributing factors to determine, if possible, how much the work environment levels of TCE are responsible.

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

SPILL/LEAK: Inform safety personnel of any trichloroethylene spill or leak and evacuate the area for large spills. Cleanup personnel must use respiratory and liquid contact protection. Adequate ventilation must be provided. Confine the spilled TCE to as small an area as possible. Do not allow it to run off to sewers or open waterways. Pick up spilled TCE with a vacuum cleaner or an absorbent such as vermiculite.

DISPOSAL: Consider reclamation, recycling, or destruction rather than disposal in a landfill.

Trichloroethylene is designated as a hazardous substance by the EPA (40 CFR .16.4).

Trichloroethylene is reported in the 1983 EPA TSCA Inventory.

EPA Hazardous Waste Number (40 CFR 261.33): U228

EPA Reportable Quantity (40 CFR 117.3): 1000 lbs (454 kgs)

Aquatic Toxicity Rating, TLm 96: Not Listed

SECTION 8. SPECIAL PROTECTION INFORMATION

GOGGLES: Always wear protective eyeglasses or chemical safety goggles. Follow the eye and face protection guidelines of 29 CFR 1910.133. GLOVES: Wear impervious gloves. RESPIRATOR: Use a NIOSH-approved respirator per the *NIOSH Guide to Chemical Hazards* (Genium ref. 88) for the maximum-use concentrations and/or the exposure limits cited in section 2. Follow the respirator guidelines in 29 CFR 1910.134. Any detectable concentration of TCE requires an SCBA, full facepiece, and pressure-demand/positive-pressure modes. WARNING: Air-purifying respirators will not protect workers from oxygen-deficient atmospheres. OTHER EQUIPMENT: Wear rubber boots, aprons, and other suitable body protection appropriate to the existing work environment. VENTILATION: Install and operate general and local exhaust ventilation systems of sufficient power to maintain airborne concentrations of TCE below the OSHA PEL standards cited in section 2. SAFETY STATIONS: Make eyewash stations, washing facilities, and safety showers available in areas of use and handling. Contact lenses pose a special hazard; soft lenses may absorb irritants, and all lenses concentrate them. OTHER SPECIAL MODIFICATIONS IN THE WORKPLACE: Because of the unresolved controversy about the carcinogenic status of TCE, all existing personal protective equipment and engineering technology should be used to prevent any possibility of worker contact with this material.

COMMENTS: Practice good personal hygiene. Keep material off of your clothes and equipment. Avoid transfer of material from hands to mouth while eating, drinking, or smoking. Adhere to the sanitation requirements of 29 CFR 1910.141 and 29 CFR 1910.142.

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

STORAGE SEGREGATION: Prevent TCE from coming into contact with strong caustics such as NaOH, KOH; chemically active metal like Ba, Li, Na, Mg, Ti; and powdered aluminum or magnesium in acidic solutions. SPECIAL HANDLING/STORAGE: Store this material in a cool, dry, well-ventilated area. Avoid elevated temperatures because products of toxic and corrosive decomposition from TCE may form. Monitor the level of any stabilizer component that may be added to the TCE. (Consult the technical data from the supplier to determine the specifics of any added stabilizer.) If applicable, follow the supplier's recommendation concerning proper rotation of stock, shelf-life requirements, and levels of stabilizers.

ENGINEERING CONTROLS IN THE WORKPLACE: Avoid collecting aluminum fines (very small particles) or chips in a TCE vapor degreaser. Monitor TCE stabilizer levels regularly. Only trained personnel should operate vapor degreasers.

TRANSPORTATION DATA (per 49 CFR 172.101-2)

DOT Hazard Class: ORM-A	DOT ID No. UN1710	IMO Class: 6.1
IMO Label: St. Andrew's Cross (X)*	DOT Shipping Name: Trichloroethylene	DOT Label: None

* Harmful - Stow away from foodstuffs (IMO Label, Materials of Class 6.1 Packaging Group III)

References: 1-9, 12, 14, 21, 73, 87-94 PI

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Approvals JC DeCristofaro

Indust. Hygiene/Safety [signature] 11-19-87

Medical Review [signature]

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Material Safety Data Sheet

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GENIUM PUBLISHING CORP.

No. 23

CADMIUM
(Revision C)
Issued: September 1977
Revised: November 1988

SECTION 1. MATERIAL IDENTIFICATION 27

Material Name: CADMIUM

Description (Origin/Uses): Used in electroplating other metals; in dentistry; in alloys; in nickel-cadmium batteries; and in reactor control rods.

Genium

Other Designations: Cd; CAS No. 7440-43-9

HMIS
H 3 R 1
F 1 I 4
R 0 S 1
PPG* K 4 (Dust)
*See sect. 8

Manufacturer: Contact your supplier or distributor. Consult the latest edition of the *Chemicalweek Buyers' Guide* (Genium ref. 73) for a list of suppliers.

SECTION 2. INGREDIENTS AND HAZARDS, EXPOSURE LIMITS

Cadmium, CAS No. 7440-43-9, ca 100%

OSHA PEL
8-Hr TWA: 0.1 mg/m³ (Cd Fume)
Ceiling: 0.3 mg/m³ (Cd Fume)
8-Hr TWA: 0.2 mg/m³ (Cd Dust)
Ceiling: 0.6 mg/m³ (Cd Dust)

ACGIH NIC,* 1988-89
TLV-TWA: 0.01 mg/m³ (Cadmium and Compounds, as Cd)
ACGIH A2, Suspected Human Carcinogen

ACGIH TLVs, 1988-89
TLV-TWA: 0.05 mg/m³ (Cadmium Dusts and Salts, as Cd)
TLV-Ceiling: 0.05 mg/m³ (Cadmium Oxide Fume, as Cd)
TLV-TWA: 0.05 mg/m³ (Cadmium Oxide Production)

Toxicity Data**
Human, Inhalation, LC_{Lo}: 39 mg/m³ (20 Minutes)

*Notice of Intended Changes, Genium reference 116, p. 39.
**See NIOSH, *RTECS* (EU9800000), for additional data referring to reproductive, tumorigenic, and mutagenic effects.

SECTION 3. PHYSICAL DATA

Boiling Point: 1413°F (767°C)
Melting Point: 610°F (321°C)
Vapor Pressure: 0.095 Torr at 610°F (321°C)
Molecular Weight: 112 Grams/Mole
Solubility in Water (%): Insoluble
Specific Gravity (H_2O = 1): 8.642

Appearance and Odor: A soft, blue white, malleable, lustrous metal that can be cut easily with a knife; odorless.
Comments: Cadmium has a significant vapor pressure of 0.000021 torr (corresponding to 0.12 mg/m³) at 315°F (157°C). Heating this metal without using correct engineering controls and/or personal protective equipment can result in overexposure.

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point and Method*	Autoignition Temperature*	LEL*	UEL*

Extinguishing Media: *Cadmium metal burns readily in air if it is heated. As with most metals, the reactivity/dust-cloud-explosion hazard increases as the cadmium metal becomes more finely divided. In fact, finely divided, powdered cadmium metal can be pyrophoric (it burns spontaneously in air without any source of ignition). Carbon dioxide, dry chemical, or sand are recommended extinguishing agents for cadmium fires. **Unusual Fire or Explosion Hazards:** Cadmium dust can explode during a fire. Massive cadmium metal does not present this potential explosion hazard; however, certain work operations such as grinding, welding, or cutting, can produce dust made of finely divided cadmium particles. **Warning:** Do not create a dust cloud of cadmium particles, especially during cutting, grinding, or welding operations. **Special Fire-fighting Procedures:** Wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode.

SECTION 5. REACTIVITY DATA

Stability/Polymerization: Cadmium is stable in closed containers during routine operations. Hazardous polymerization cannot occur. **Chemical Incompatibilities:** Cadmium reacts dangerously with ammonium nitrate, hydrazoic acid, tellurium, and zinc (Genium ref. 84). **Conditions to Avoid:** Avoid all exposure to sources of ignition and to incompatible chemicals. **Hazardous Products of Decomposition:** When heated, which is likely during fires and work operations such as welding and machining, cadmium metal can decompose into cadmium metal fume and cadmium oxide fume.

SECTION 6, HEALTH HAZARD INFORMATION

Carcinogenicity: The ACGIH classifies cadmium and its compounds as suspected human carcinogens (group A2); the IARC lists them as probable human carcinogens (group 2B); and the NTP classifies them as anticipated human carcinogens (group b). **Summary of Risks:** *Heating cadmium metal produces intensely irritating cadmium metal fume.* The acute effects of its excessive inhalation, which include severe tracheobronchitis, pneumonitis, and pulmonary edema, are life threatening and are usually delayed for several hours; their mortality rate is about 20%. Nonfatal pneumonitis has resulted from exposure to 0.5 to 2.5 mg/m³; a fatality has been reported for five hours' exposure at 9 mg/m³ and for 1 hour's exposure at 40 to 50 mg/m³. There is no warning discomfort or immediate irritation from exposure to cadmium fume. Acute gastroenteritis and symptoms of metal fume fever are associated with even lower acute exposure. Symptoms of acute overexposure include excessive salivation, a dry, burning throat; headache; aching muscles; coughing; chest tightness and pain; nausea; chills, and fever chills; and fever. **Medical Conditions Aggravated by Long-Term Exposure:** None reported. **Target Organs:** Skin, eyes, respiratory system, kidneys, and blood. **Primary Entry:** Inhalation, skin contact. **Acute Effects:** See Summary of Risks, above. **Chronic Effects:** Long-term, chronic inhalation of cadmium dust, salts, or fume causes chronic cadmium poisoning characterized by a distinctive, nonhypertrophic emphysema with or without renal tubular injury, accompanied by the urinary excretion of a protein with a molecular weight

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SECTION 6. HEALTH HAZARD INFORMATION, cont.

of 20,000 to 30,000. This protein is itself a sign of early but reversible chronic poisoning. (Possible chromosomal aberrations and decreased birth weight among babies of women exposed to cadmium have been noted.) **Danger:** Continued overexposure from inhalation causes irreversible renal tubular damage. Cancer, anemia, eosinophilia, anosmia, chronic rhinitis, yellowed teeth, and bone changes have been reported. Bone pain in the ribs, backbone, and femur is common; disorders of calcium metabolism develop; and kidney stones and pulmonary fibrosis have been described. **FIRST AID: Eyes.** Immediately flush eyes, including under the eyelids, gently but thoroughly with flooding amounts of running water for at least 15 minutes. **Skin.** Rinse the affected area with flooding amounts of water, then wash it with soap and water. **Inhalation.** Remove the exposed person to fresh air; restore and/or support his or her breathing as needed. Have qualified medical personnel administer oxygen as required. **Ingestion.** If a physician is not readily available, give the exposed person 2 to 3 glasses of water to drink and induce vomiting. A physician may administer a gastric lavage followed by saline catharsis. **Comments:** A comprehensive medical program is advised for those who work with cadmium or its compounds. This should include chest X rays and forced-vital-capacity tests. **Get medical help (in plant, paramedic, community) for all exposures.** Seek prompt medical assistance for further treatment, observation, and support after first aid. **Note to Physician:** Chelation therapy may be useful in treatment; calcium disodium edetate and pencillamine are recommended. Dimercaprol (BAL) is not recommended because of reported renal toxicity of the cadmium-BAL complex.

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

Spill/Leak: Notify safety personnel, evacuate unnecessary personnel, eliminate all sources of ignition immediately, and provide adequate ventilation. Cleanup procedures must not create dusty conditions. Pick up the spilled material using vacuuming, mopping, or wet-sweeping techniques. Cleanup personnel need protection against inhalation of dust and fume (see sect. 8). **Waste Disposal:** Contact your supplier or a licensed contractor for detailed recommendations. Follow Federal, state, and local regulations. Concentrated solutions of cadmium waste can be precipitated with lime and collected by filtration. Effluent should be treated as needed to reduce the concentration of the cadmium to a level that is within regulatory compliance limits.

OSHA Designations
Listed as an Air Contaminant (29 CFR 1910.1000 Subpart Z).
EPA Designations (40 CFR 302.4)
RCRA Hazardous Waste, No. D006 (40 CFR 261.24 [Characteristic of EP toxicity])
CERCLA Hazardous Substance, Reportable Quantity: 1 lb (0.454 kg), per the Clean Water Act (CWA), § 307 (a).

SECTION 8. SPECIAL PROTECTION INFORMATION

Goggles: Always wear protective eyeglasses or chemical safety goggles. Where splashing of a cadmium solution is possible, wear a full face shield. Follow OSHA eye- and face-protection regulations (29 CFR 1910.133). **Respirator:** Use a NIOSH-approved respirator per Genium reference 88 for the maximum-use concentrations and/or the exposure limits cited in section 2. Follow OSHA respirator regulations (29 CFR 1910.134). For emergency or nonroutine operations (spills or cleaning reactor vessels and storage tanks), wear an SCBA. **Warning:** Air-purifying respirators will *not* protect workers in oxygen-deficient atmospheres. **Other:** Wear impervious gloves, boots, aprons, and gauntlets, to prevent prolonged or repeated skin contact with this material. **Ventilation:** Install and operate general and local maximum explosion-proof ventilation systems powerful enough to maintain airborne levels of cadmium below the OSHA PEL cited in section 2. Local exhaust ventilation is preferred because it prevents dispersion of the contaminant into the general work area by eliminating it at its source. Consult the latest edition of Genium reference 103 for detailed recommnedations. **Safety Stations:** Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work areas. **Contaminated Equipment:** Contact lenses pose a special hazard; soft lenses may absorb irritants, and all lenses concentrate them. Do *not* wear contact lenses in any work area. Remove contaminated clothing and launder it before wearing it again; clean this material from your shoes and equipment. Do not wear work clothes home. **Comments:** Practice good personal hygiene; always wash thoroughly after using this material and before eating, drinking, smoking, using the toilet, or applying cosmetics. Keep it off your clothing and equipment. Avoid transferring it from your hands to your mouth while eating, drinking, or smoking. Do *not* eat, drink, or smoke in any work area. Do not inhale cadmium fume. Do not expose individuals with lung, liver, kidney, and blood ailments to cadmium until such exposure is approved by a physician.

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

Storage/Segregation: Store cadmium in closed containers in a cool, dry, well-ventilated area away from sources of ignition and strong oxidizers. Protect containers from physical damage. Avoid storage situations where corrosion can occur. Keep powdered cadmium in closed containers; prevent the airborne dispersion of powdered cadmium. **Engineering Controls:** Make sure all engineering systems (production, transportation) are of maximum explosion-proof design. Ground and bond all containers, pipelines, etc., used in shipping, transferring, reacting, producing, and sampling operations to prevent static sparks. **Other Precautions:** The toxic effects of cadmium are influenced by the presence or absence of other elements such as zinc and selenium. If these materials are present in the workplace, careful evaluation of any exposure to cadmium is required to understand any contributing factors.

Hazardous Materials Table (49 CFR 172.101): Not Listed
Optional Hazardous Materials Table (49 CFR 172.102)

ID No. UN2570

IMO Shipping Name: Cadmium Compounds
IMO Hazard Class: 6.1
IMO Labels: Poison or Saint Andrew's Cross (X)*

*Harmful--Stow away from Foodstuffs (IMO Label, Materials of Class 6.1 Packaging Group III).

References: 1, 26, 38, 84-94, 100, 116, 117, 120, 122.

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Prepared by PJ Igoe, BS
Industrial Hygiene Review: DJ Wilson, CIH
Medical Review: W Silverman, MD

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TANTALUM
MATERIAL SAFETY DATA SHEET

ICN BIOMEDICALS --TANTALUM, 218713
MATERIAL SAFETY DATA SHEET
NSN: 681000N055292
Manufacturer's CAGE: 30060
Part No. Indicator: A
Part Number Trade Name: TANTALUM, 218713

General Information

Company's Name: ICN BIOMEDICALS
Company's Street: 1263 S CHILLICOTHE RD
Company's City: AURORA
Company's State: OH
Company's Country: US
Company's Zip Code: 44202
Company's Emerg Ph #: 800-424-9300 (CHEMTREC)
Company's Info Ph #: 216-562-1500
Record No. For Safety Entry: 001
Tot Safety Entries This Stk#: 001
Status: SMJ
Date MSDS Prepared: 26JAN94
Safety Data Review Date: 14NOV94
MSDS Preparer's Name: RL
Preparer's Company: SAME
MSDS Serial Number: BWDGF
Hazard Characteristic Code: NK

Ingredients/Identity Information

Proprietary: NO
Ingredient: TANTALUM
Ingredient Sequence Number: 01
NIOSH (RTECS) Number: WW5505000
CAS Number: 7440-25-7
OSHA PEL: 5 MG/M3
ACGIH TLV: 5 MG/M3; DUST

Physical/Chemical Characteristics

Appearance And Odor: GRAY DUCTILE METAL.
Boiling Point: 9804F,5429C
Melting Point: 5425F,2996C
Specific Gravity: 16.69
Solubility In Water: INSOLUBLE.

Fire and Explosion Hazard Data

Extinguishing Media: CO*2, DRY CHEMICAL, FOAM.
Special Fire Fighting Proc: WEAR NIOSH/MSHA APPROVED SCBA & FULL PROTECTIVE EQUIPMENT(FP N).
Unusual Fire And Expl Hazrds: NONE SPECIFIED BY MANUFACTURER.

Reactivity Data

Stability: YES
Cond To Avoid (Stability): NONE SPECIFIED BY MANUFACTURER.
Materials To Avoid: OXYGEN, HALOGENS, BROMINE TRIFLUORIDE, FLUORINE, STRONG BASES, LEAD CHROMATE IGNITES SPONTANEOUSLY IN AIR.
Hazardous Decomp Products: ACRID SMOKE & FUMES.
Hazardous Poly Occur: NO
Conditions To Avoid (Poly): NOT RELEVANT.

Health Hazard Data

LD50-LC50 Mixture: NONE SPECIFIED BY MANUFACTURER.
Route Of Entry - Inhalation: YES
Route Of Entry - Skin: YES
Route Of Entry - Ingestion: YES
Health Haz Acute And Chronic: TOXICOLOGICAL PROPERTIES HAVE NOT BEEN

THOROUGHLY INVESTIGATED. POSSIBLE TOXIC VIA ORAL, SKIN & MUCOUS MEMBRANES. MODERATE TO SEVERE ERYTHEMA (REDNESS) AND MODERATE EDEMA (RAISED SKIN).
Carcinogenicity - NTP: NO
Carcinogenicity - IARC: NO
Carcinogenicity - OSHA: NO
Explanation Carcinogenicity: NOT RELEVANT.
Signs Symptoms Of Overexp: SEE HEALTH HAZARDS.
Med Cond Aggravated By Exp: NONE SPECIFIED BY MANUFACTURER.
Emergency First Aid Proc: SKIN: REMOVE CONTAMD CLTHG, RINSE LIBERALLY W/SOAP & WATER FOR A CONSIDERABLE PERIOD. CALL MD. INGEST: RINSE MOUTH SEVERAL TIMES WITH WATER, DO NOT SWALLOW. CALL MD/TAKE PATIENT TO HOSPITAL. TAKE THE PATIENT INTO THE FRESH AIR & ALLOW TO REST. CALL MD/TAKE PATIENT TO HOSPITAL.

Precautions for Safe Handling and Use

Steps If Matl Released/Spill: SWEEP INTO SUITABLE CONTAINER FOR DISPOSAL.
Neutralizing Agent: NONE SPECIFIED BY MANUFACTURER.
Waste Disposal Method: INCINERATE OR LANDFILL AS COMPLIES WITH LOCAL, STATE & FEDERAL LAWS.
Precautions-Handling/Storing: ALWAYS WEAR GLOVES, MASK, GOGGLES & USE A HOOD. STORE AT ROOM TEMPERATURE.
Other Precautions: NONE SPECIFIED BY MANUFACTURER.

Control Measures

Respiratory Protection: USE NIOSH/MSHA APPROVED RESPIRATOR APPROPRIATE FOR EXPOSURE OF CONCERN (FP N).
Ventilation: LOCAL EXHAUST REQUIRED.
Protective Gloves: IMPERVIOUS GLOVES (FP N).
Eye Protection: ANSI APPRVD CHEM WORKERS GOGGLES(FP N).
Other Protective Equipment: NONE SPECIFIED BY MANUFACTURER.
Work Hygienic Practices: NONE SPECIFIED BY MANUFACTURER.
Suppl. Safety & Health Data: NONE SPECIFIED BY MANUFACTURER.

Transportation Data

Disposal Data

Label Data

Label Required: YES
Technical Review Date: 14NOV94
Label Date: 14NOV94
Label Status: G
Common Name: TANTALUM, 218713
Chronic Hazard: NO
Signal Word: CAUTION!
Acute Health Hazard-Slight: X
Contact Hazard-Slight: X
Fire Hazard-None: X
Reactivity Hazard-None: X
Special Hazard Precautions: ACUTE: POSSIBLY TOXIC VIA ORAL, SKIN & MUCOUS MEMBRANES. MODERATE TO SEVERE ERYTHEMA (REDNESS) AND MODERATE EDEMA (RAISED SKIN). CHRONIC: NONE LISTED BY MANFACTURER.
Protect Eye: Y
Protect Skin: Y
Protect Respiratory: Y
Label Name: ICN BIOMEDICALS
Label Street: 1263 S CHILLICOTHE RD
Label City: AURORA
Label State: OH
Label Zip Code: 44202
Label Country: US
Label Emergency Number: 800-424-9300 (CHEMTREC)

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ATTACHMENT C
CONTRACTOR CERTIFICATION

CONTRACTOR CERTIFICATION

I,

as an agent of_____, do hereby certify that the following employees have successfully completed a 40 hour training course which complies with the provisions of 29 CFR 1910.120. Each employee has successfully completed a medical examination which complies with the above regulations.

Individual copies of certification of successful completion of the required training and medical examination for each employee must be provided to the Project Manager.

_____ _____

Signature Date

ATTACHMENT D

EXCLUSION ZONE ENTRY LOG

EXCLUSION ZONE ENTRY LOG

Printed Name	Signature	Date	Time In	Time Out

Reporting Limit (RL) - the Reporting limit is a tool used by the laboratory to establish a criteria based on laboratory experience or specific client needs. RL's are always established at or above the MDL but may or may not be above the PQL. RL's are generally set by client Data Quality Objectives (DQO) or the lowest reproducible standard in the calibration curve.

8.5 Instrument Maintenance

Great Lakes Analytical is dedicated to providing our clients with state-of-the-art technology. Instrumentation is purchased with sensitivity, accuracy, efficiency, and dependability as criteria. All instruments have log books in which calibrations, adjustments, routine maintenance, and any repairs are recorded. Calibrations, routine maintenance, and adjustments are part of the analysts' responsibilities. Service contracts are in place for some of the instruments for any major repairs. The highest quality gases, reagents and spare parts are kept on hand to minimize repair time and optimize instrument performance.

Each entry in the instrument log book includes the date, the analyst, a detailed description of the problem, a detailed explanation of the solution, and a verification that the instrument is functioning properly. In addition, standard operation procedures for organic methods specify and require documentation of routine maintenance procedures like changing of septa in injection ports, changing of gas tanks, and cleaning of detectors.

8.6 Control Limits

The analytical process is controlled not only by instrument calibration as discussed above but by quality control measurements of the labor intensive portions of the analysis as well. These involve measurements of method blanks, accuracy and precision. Before any analytical batch is analyzed, a check standard and reagent blank are analyzed to verify that the method is in control. The quality control samples are analyzed to determine the quality of the analytical process. All QC must pass for data to meet final approval.

8.6.1 Method Blank

The method blank must be free of contamination to determine that the extraction or preparation batch was free from contamination from an outside source and to prevent the overestimation of contaminants in the environmental samples.

With the exception of a few compounds for a few analyses, the method blank should quantitate to a value of less than half the PQL (or reported detection limit) for the analytes of interest. The exceptions are enumerated in the specific standard operating procedures.

8.6.2 Accuracy

Great Lakes Analytical incorporates Blank Spikes or a Laboratory Control Sample (LCS) into each batch of samples to evaluate the accuracy of the process. Blank Spikes and the LCS are essentially the same; reagent water or sand spiked with the target analyte(s) and carried through the entire analytical process. A Blank Spike and Blank Spike Duplicate are analyzed when a sample is not available for spiking. A LCS is a single blank spike that is analyzed when a sample is available for Matrix Spike and Matrix Spike Duplicate.

8.6.2.1 Accuracy - General Procedure

Accuracy measurements are performed every 20 samples or once every analytical batch per matrix type. A sample or blank matrix for the analytical batch is spiked with a known quantity of the analyte(s) and analyzed in the same manner as the rest of the analytical batch. Each day samples are extracted or analyzed a minimum of one LCS and one blank must also be run. The percent recovery is calculated and documented (Figure 5 in Appendix). Percent recovery is calculated as follows:

$$\% \text{ Recovery} = \frac{\text{Conc. of Matrix Spike - Conc. of Sample}}{\text{Spike Conc. Added}} \times 100$$

The percent recovery of an analyte in a spiked sample must fall within the control limits set for that analyte. For the procedure for establishing control limits see section 8.6.5.1.

8.6.2.2 Exceptions to Accuracy General Procedure

Specific projects or regulatory agencies may require accuracy measurements more stringent than those described above. In such cases the laboratory will operate at the higher level of quality control required. In no case will the laboratory perform at a level lower than that described in the general procedure.

8.6.3 Precision

Great Lakes Analytical uses the Blank Spike and Blank Spike Duplicate or, in the case when only a LCS is analyzed, the Matrix Spike and Matrix Spike Duplicate to evaluate precision for an analytical batch.

8.6.3.1 Precision - General Procedure

Precision measurements are performed every Virtual Batch or 20 samples, but not less than once a week, per matrix type. Precision is measured by comparing the recoveries of identical samples. The Virtual Batch is a set of 20 or less samples run in a seven day period, all of which are associated with the same precision samples. For example:

Monday: 10 soil samples are received for analysis. A Blank, LCS, Matrix Spike and Matrix Spike Duplicate are run with the Daily Batch and reported.
Wednesday: 10 more soil samples are received for analysis. A Blank and LCS are run with this Daily batch and reported along with the Matrix Spike and Matrix Spike Duplicate from Monday. This Virtual Batch is complete because it contains 20 samples within the seven day period.

Precision data may be generated for matrix or blank samples, however, the matrix sample is preferred because it better approximates the performance of the method on real world samples. In the case of ground water and waste water samples a separate sample volume is not often provided for matrix spiking. In these situations the frequency will be blank spike and duplicate every Virtual Batch or 20 samples, but not less than once a week, with a blank and LCS analyzed with each consecutive batch during that week. Both the matrix spike (MS) and the matrix spike duplicate (MSD) are analyzed in the same manner as rest of the analytical batch. The relative percent difference between the two spiked duplicates is calculated and documented (Figure 5 in Appendix). The relative percent difference is calculated as follows (reported as the absolute value):

$$\text{Relative \% difference} = \frac{\text{Conc. of MS - Conc. of MSD}}{(\text{Conc. of MS + Conc. of MSD})/2} \times 100$$

The relative percent difference for a particular analyte must fall within the control limit established for that analyte. For the procedure for establishing control limit see section 8.6.5.1.

8.6.3.2 Exceptions to Precision General Procedure

Specific projects or regulatory agencies may require precision measurements more stringent than those described above. In such cases the laboratory will operate at the higher level of quality assurance required. In no case will the laboratory perform at a level lower than that described in the general procedure.

8.6.4 Surrogates

In most organic analyses surrogate compounds are spiked into all environmental and quality control samples. . They act as a secondary check on method performance in that they must meet established acceptable recovery limits. These limits define the minimum and maximum recoveries that must be obtained for the particular environmental matrix. Limits are set semi-annually based on 15 - 20 consecutive data points per each matrix. Data points used to determine the control limits are evaluated using a statistical out-liers test.

Samples that fail to meet the limits are evaluated to determine the cause of the result. If no acceptable reason can be found the samples are re-extracted and reanalyzed. If the data is still outside of the acceptable limits the data is appropriately flagged.

8.6.5 Evaluating Quality Control

In order to assure our clients of the validity of their data, Great Lakes Analytical's analysts have been trained to constantly be evaluating the quality of the analytical process. That means checking not only the validity of the instrument calibration, but also measurements of accuracy and precision. As an analytical batch is analyzed, control measures are processed concurrently to assist in assessing the quality of the data generated. The analysts use control limits to evaluate accuracy, precision and trends in the analytical process.

8.6.5.1 Control Limits

In order to demonstrate control over a method Great Lakes Analytical has first had to determine and quantify normal performance. To do this we have established certain prerequisites for consistent performance. They are:

1. Use of approved analytical methods.
2. Personnel trained and experienced with the particular method.
3. Proper facilities and equipment.
4. Certified reagents and standards.
5. Frequent maintenance and calibration of the instruments.
6. Knowledgeable management to oversee the analytical process.

When a new method is put into use the initial control limits are established from the ones published in the method or the Quality Control section of the guidance document. After a minimum of 20 QC Batches have been analyzed the control limits for precision and accuracy will be calculated.

The control limits are set 3 standard deviation units from the average. The upper control limit is +3 standard deviations, and the lower control limit is -3 standard deviations. For Precision the control limits are set from 0 to +3 standard deviations from the relative percent difference.

On an annual basis the analyst, Department Manager and Quality Assurance Manager will review the compiled data points to evaluate if the limits need to be changed. Data will be evaluated for how well the limits fit the data using a method such as the Grubbs Test for Out-liers. Warning limits maybe established inside the calculated control limits to tighten control over an analysis. Separate control limits will be established for each matrix and each QC parameter. Great Lakes Analytical will adhere to any control limits set by a certification program in which the lab participates. Otherwise, the limits adhered to will be those established by the Quality Assurance Program.

8.7 Materials

Material purchased for use in the analytical process are all of the an acceptable purity or quality commercially available for the intended purpose. This includes all gases used in gas chromatography, all solvents, acids, and bases used in extraction or digestion, dilution, and standard preparation, stock standards, and any other routinely restocked items.

8.8 Cleaning Procedures

The following is the general cleaning procedures used for most analytical glassware at Great Lakes Analytical.

1. Rinse with hot tap water.
2. Scrub with detergent.
3. Rinse 3 times with hot tap water.
4. Rinse 3 times with deionized water.
5. Air dry and store.

Specific EPA methods require procedures that may vary from the cleaning procedures listed above. These specific standard operating procedures are posted in the glassware cleaning area and are kept on record with the appropriate analysts and the Quality Assurance Manager.

9. CORRECTIVE ACTION

A Quality Control Program must have corrective actions built into every standard operating procedure. The program is only as effective as the laboratory's ability to adhere to the program. If the level of acceptability set by the method or source document is not met, corrective action must be taken immediately. In accordance with EPA SW-846 Chapter 1, Revision 1, July 1992, the following steps are taken to maintain the integrity of the final data package:

1. Identification and definition of the problem;
2. Assignment of responsibility for investigating the problem;
3. Investigation and determination of the cause of the problem;
4. Determination of a corrective action to eliminate the problem;
5. Assigning/accepting responsibility for implementing the corrective action;
6. Implementing the corrective action and evaluating its effectiveness;
7. Verifying that the corrective action has eliminated the problem.

These steps apply to any and all standard operating procedures at Great Lakes Analytical (Figure 6 in Appendix). If The Corrective Actions are documented on a Corrective Action Report it is routed by the following path;

-Corrective Action Forms are assigned a log number specific to the department of origin then routed to the Department Manager .

-The Department Manager routes the form to the Project Manager (if data is to be flagged) for verification that affected samples have been flagged. See section 12 for details on flagging data.

-If no data is affected then the form is forwarded to the QA Manager.

-The Project Managers sign and return the Form to the QA Manager verifying that all data has been properly flagged.

-The QA Manager then closes the Corrective Action by signing it. The copies of completed Corrective Action forms are filed by the Department Manager.

The QA/QC Manager and Department Manager regularly review the corrective actions to identify problem areas needing closer scrutiny. Annually the QA Manager and Lab Manager review the corrective action activity for the past year to identify areas of concern and to assure proper corrective action procedures are being adhered to by each department.

10. INTERNAL QUALITY CONTROL CHECKS

Great Lakes Analytical utilizes five different organizations to participate in eight Performance Evaluation programs. All are single blind and scheduled throughout the year. The list of programs is as follows:

Organization	Program	Analysis Sets
Annually		
Environmental Research Associates	Real World Matrix	2
Environmental Research Associates	Drinking Water	4
New York Dept. of Health	Non-Potable Water	2
New York Dept. of Health	Potable Water	2
EPA Water Supply	Drinking Water	2
EPA Water Pollution	Waste Water	2
Wisconsin DNR	Env. Ref. Sample Program	1
ELPAT	Lead in Paint Chips, Soils, Wipes and Air	4

Clients are encouraged to submit quality control samples to Great Lakes and on request, arrangements will be made to split samples and subcontract to another laboratory as a confirmatory check.

In addition, a stock of performance evaluation samples are kept to be administered blind to the analyst at the discretion of the QA Manager for more frequent internal performance checks.

11. INTERNAL AUDITS

Performance audits are done every quarter for every analyst. The audit responsibility can be divided between the QA Manager and the Department Manager, with each performing the audits . Audit forms have been designed for each analysis type to focus on the important documentation and procedural steps.

The auditors review the analyst's notebook for documentation of all quality control measurements, their frequency, and the clarity of the documentation . The notebook must be useful to any person who wishes to inspect the history of the analysis. Analysts must also have equipment logs, repair manuals, and adequate tools to keep instruments calibrated. The analyst's data reporting procedures are also reviewed to ensure that results can be easily traced to a notebook. The results of a system audit are discussed with the Department Manger, who will then review the findings with the appropriate analyst(s) and kept on file. If any discrepancies are noted, corrective actions are initiated.

Periodically following each audit , the QA Manager and Department Manager hold a meeting to review audit deficiencies and the progress of corrective actions. Annually the QA Manager and Lab Manager review the audit findings and implement any additional changes necessary to improve the quality system.

12. DATA REDUCTION, VALIDATION, REPORTING, AND RECORDKEEPING

12.1 Recordkeeping

12.1.1. The QA Manager has the responsibility for maintaining a master log of all log books issued to analysts.

12.1.2. All log books are issued a unique identification number. Log books are labeled with the following information:

- 12.1.2.1. Log Book Title
- 12.1.2.2. Identification Number
- 12.1.2.3. Issue Date
- 12.1.2.4. End Date

12.1.3 When filling out data log books with preprinted rows and columns specific to a particular test, all applicable spaces must be filled out. If a space is not used a line will be drawn through it. For un-formatted data log books the following information must be recorded:

- 12.1.3.1. Client Name
- 12.1.3.2. Full Sample Number
- 12.1.3.3. Matrix Type
- 12.1.3.4. Method
- 12.1.3.5. Amount of sample used
- 12.1.3.6. Dilutions complete with units
- 12.1.3.7. GLA Code Number for standards used
- 12.1.3.8. Lot Number for solvents/acids (if applicable)
- 12.1.3.9. Results (if applicable), with units
- 12.1.3.10. Analysts Initials
- 12.1.3.11. Date of Analysis

12.1.4. All entries into laboratory notebooks must be in pen and be neat and legible. Mistakes will be crossed-out with a single line and initialed and dated. Pencil, white-out and obliterated errors are unacceptable.

12.1.5. Unused or partially used pages must be "Z'd" out.

12.1.6. All calculations will be shown or represented with a generic calculation at the front of the note book.

12.1.7. For more complex and long bench time tests it is not uncommon for multiple analysts to work on a single batch or page. This may involve analysts on the same shift or a shift to shift continuation of the analytical process. Many of the preprinted log books incorporate spaces for multiple analysts initials at various stages in the analytical process. Anytime an entry is made by an analyst other than the "signing" analyst it will be accompanied by the analyst's initials and date of the entry.

12.1.8. Completed lab note books are to be labeled with the date of the last entry and turned in to the QA Manager. Any unused pages will be "Z'd" out.

12.1.9. Log books will be archived for 5 years.

12.2 Data Review

Data travels through several processes before the final data package is released to the client. The path from the instrument response to the final report begins with the documentation of all testing parameters in the analyst's notebook.

Examples for all sample calculations as well as the quality control measurements are documented in the notebook or SOP for the specific method. Review of the analysis data, from the original data to the result reported, is completed by a peer or department manager.

The analysts are responsible for transferring the data to a set of laboratory worksheets. The worksheets are generated specific to the client's requests on the chain of custody. When completed the worksheets are submitted to the Project Manager for review.

At a minimum the standard laboratory report shall contain the following information:

- Client name and address
- Client project manager or contact
- Client sample identification and project name or number
- Laboratory sample number
- Date sampled
- Date received
- Date extracted or digested (if applicable)
- Date analyzed
- Method of analysis including EPA method code (if applicable)
- Practical Quantitation Limit or Reporting Limit
- Method Detection Limit (if required)
- Sample results
- Definition of ND
- Elevated detection limit statement if sample was reported at a dilution
- QC data consisting of Surrogate, LCS and MS/MSD recoveries and control limits

- Identification of any QC parameters which failed on cover letter, corresponding data summary page and corresponding QC page.
- Any QC parameter which fails should be added to the report if not already included (e.g.: surrogates, internals, blank, check standard etc.)
- Any data reported between the Practical Quantitation Limit and the Method Detection Limit shall be flagged with a "J". When used this flag will be defined in the report.
- Any data reported which has been quantitated above the highest calibration standard shall be flagged with an "E". When used this flag will be defined in the report.
- Any analyte reported which was also found in the associated blank shall be flagged with a "B". When used this flag will be defined in the report and the blank results shall be reported.
- Data reported pending the resolution of QC deficiencies (sample or QC being re-run or re-extracted) shall be clearly marked as "TENTATIVE RESULTS". When such data is reported the QC deficiencies associated with the samples must be discussed with the client.
- Any data reported that has been identified to be a laboratory artifact will be flagged with an "A"
- Any unusual circumstances or observations associated with a sample will be noted in the report.
- Signature of the Project Manager.
- Copy of the Chain of Custody.

The Project Manager reviews the results, and checks that the analyses performed are appropriate to the client's requests. Related analyses from the same sample are compared for coherence, and the data is compared with previous results from the same source to observe any deviations from established trends. Unusually high results, or those clearly in violation of discharge limits or hazardous waste standards, are reviewed carefully for any reporting unit errors and frequently trigger an examination of the analyst's notebook and instrument printouts to check for calculation errors. The Project Manager verifies that data is flagged as necessitated by any corrective actions which may apply to the report being reviewed. The Project Manager initials and dates the Corrective Action and routes it to the QA Manager. Final review often involves further consultation with clients. After typing, the report is again reviewed by the Project Manager to ensure accurate transfer of information from the laboratory worksheets to the final report.

The Project Manager signs the report after their final review of the report. Copies of final reports are kept in a secure filing area for a minimum of five years and include the original laboratory worksheets and the chain of custody.

13. TRAINING

When reporting for work for the first time, all new employees receive a copy of the Personnel Policy Manual, and if appropriate for their job function the Chemical Hygiene Plan, and a copy of the Quality Assurance Program manual. These are his or hers to keep as part of his or her reference materials. The sole responsibility of the new employee is to read and understand the contents of these manuals. Once the new employee has read and understood the contents of the manual, he or she must sign a document that states that he or she agrees to adhere to the requirements prescribed therein. Additionally the new employee will receive appropriate training on one or more of these documents (See the SOP for Employee Training for further details concerning both new employee and ongoing employee training programs). These records are kept on file with the QA Manager . Only then does further on the job training take place.

The Personnel Policy Manual contains information about the company's history and objectives, administrative scheduling, benefits, and general administrative policies.

The Chemical Hygiene Plan contains pertinent information about the chemicals to which employees may be exposed and how to properly interact with those chemicals, preventative procedures to avoid emergencies as well as procedures to cope with emergencies like spills, injuries and fire.

The Quality Assurance Program manual contains information about the goals of the Quality Assurance Program and their implementation.

Each new analyst reviews reference binders that includes copies of the SOP's and source methods for which he or she will be held responsible, all related extraction, cleanup, and dilution methods, analytical standard operating procedures, all relevant quality control documentation forms, standard operating procedures for filling out those forms, and procedures for troubleshooting and corrective action.

Additional verbal instruction from both the previous analyst and a quality assurance staff member is provided to ensure a thorough understanding of the requirements set out by the Quality Assurance Program Manual and the analytical methods. The previous analyst then introduces the new analyst to all the instrumentation involved in his or her analyses. Standard operating procedures, preventative maintenance, and troubleshooting for the instrument are reviewed by both the previous and new analyst. The maintenance logbook is explained and any history specific to an instrument is reviewed by the previous and the new analyst. (Refer to the SOP for Employee Training)

Once the new analyst feels comfortable with all the documentation requirements and demonstrates an ability to operate the instrumentation satisfactorily, he or she will spend time observing the actual performance of the analysis by the previous analyst, gradually helping at various steps in the process in the presence of the previous analyst. Eventually, the new analyst will perform the entire analysis in the presence of the previous analyst to ensure adequate proficiency. Once the new analyst has demonstrated proficiency in the analytical procedures and has demonstrated the ability to maintain quality assurance documentation, he or she will submit quality control results from a sample batch. The results of these analyses are reviewed by the QA Manager and a training check list is completed by the Department Manager. These documents are placed in a training file for the employee. The records are kept on file with the QA Manager.

Successful completion of the analyses of the internal quality control check samples entails the submission of a value that is within the acceptable range. . The Department Manager must be satisfied that the new analyst understands the methods he or she will be performing, quality control parameters and documentation of any corrective action that may be necessary. After the successful completion of the analyses of the internal quality control check samples and a training check list, the new analyst is capable of assuming responsibility for the analysis. If the new analyst does not meet these requirements, he or she continues to work with the previous analyst until both requirements are passed successfully.

Once the new analyst has assumed responsibility for the analysis, routine review of data by the new analyst's supervisor continues as part of regular data review processes. Regular auditing by quality assurance staff members ensures continued compliance with Quality Assurance requirements.

14. EQUIPMENT AND FACILITIES

Great Lakes Analytical's laboratory occupies a 14,000 square foot custom designed facility. Great Lakes is constantly upgrading its instrumentation capabilities. Major instruments and equipment include:

14.1 Organic Analytical Equipment

14.1.1 Gas Chromatography/Mass Spectroscopy (GC/MS)

GC/MS-1 Installed 8/91

Hewlett-Packard 5971 Mass Selective Detector
Hewlett-Packard 5890 II Gas Chromatograph
Restek RTX - 502.2 60M X 0.53 mm column for EPA Method 624, 8260
Tekmar LSC 2000 Purge and Trap
ALS 2016 Auto-Sampler & Auto-Sampler Heater
MS-DOS Instrumentation Control software
Hewlett-Packard Chemstation and Enviroquant Target Data Management System

GC/MS-2 Installed 11/91

Hewlett-Packard 5971 Mass Selective Detector
Hewlett-Packard 5890 II Gas Chromatograph
J&W DB5MS 0.32 mm X 30M Column for EPA Method 625, 8270
Hewlett-Packard 7673A Auto-sampler
MS-DOS Instrumentation Control Software
Hewlett-Packard Chemstation and Enviroquant Target Data Management System

GC/MS-3 Installed 5/94

Hewlett-Packard 5972 Mass Selective Detector
Hewlett-Packard 5890 II Gas Chromatograph
J&W DB 624 0.53 mm X 75 M Column for EPA methods 624, 8260
Tekmar LSC 3000 Purge and Trap
ALS 2016 Auto-Sampler & Auto-Sampler Heater
MS-DOS Instrumentation Control Software
Hewlett-Packard Chemstation and Enviroquant Target Data Management System

14.1.2 Gas Chromatographs

GC-1 Installed 8/90

Hewlett-Packard 5890 II Gas Chromatograph
Restek RTX-502.2 105 M Column for EPA 502.2, 8021, 601, and 602
OI Corp. ELCD/PID Detectors
MS-DOS Instrumentation Control Software
Hewlett-Packard Chemstation and Enviroquant Target Data Management System
Tekmar LSC 2000 Purge and Trap
Tekmar ALS 2016 Auto-sampler

GC-2 Installed 12/90

Hewlett-Packard 5890 II Gas Chromatograph
J&W DB5 608 30 M X 0.53 mm column for Methods 8080 and 8150
ECD/ECD Detectors
MS-DOS Instrumentation Control Software
Hewlett-Packard Chemstation and Enviroquant Target Data Management System
Hewlett-Packard 7673A Auto-sampler

GC-3 Installed 11/91

Hewlett-Packard 5890 II Gas Chromatograph
Restek 502.2 0.53 mm X 60 M Column for Methods 8021, TPH-Gas, GRO/PVOC
FID/PID Detectors
2 Hewlett-Packard 3396 II Integrators
Tekmar 2000 Purge and Trap
Tekmar ALS 2016 Autosampler

GC-4 Installed 11/91

Hewlett-Packard 5890 II Gas Chromatograph
J&W DB-1 60M X 0.32 mm and DB5 0.53 mm X 30 M columns for Methods 8015, 8100, DRO, TPH-Diesel, and Glycols and Industrial Solvents
FID/FID Detectors
MS-DOS Instrumentation Control Software
Hewlett-Packard Chemstation and Enviroquant Target Data Management System
Tekmar SHS 7000 Static Headspace Sampler
Tekmar SHS 7050 Auto Sampler
Hewlett-Packard 3396 II Integrator

GC-5 Installed 6/92

Hewlett-Packard 5890 II Gas Chromatograph
J&W DB624 0.53 mm X 30 M column for Method 8021, TPH-Gasoline and GRO/PVOC
FID/PID Detectors
2 Hewlett-Packard 3396II Integrators
Tekmar LSC 2000 Purge and Trap
Tekmar ALS 2016 Auto-sampler

GC-6 Installed 1/93

Hewlett-Packard 5890 II Gas Chromatograph
J&W DB-624 105M X 0.53 mm column for EPA 8021,601 and 602
OI Corp. ELCD/ PID Detectors
MS-DOS Instrumentation Control Software
Hewlett-Packard Chemstation and Enviroquant Target Data Management System
Tekmar LSC 2000 Purge and Trap
Tekmar ALS 2016 Auto-sampler

GC-7 Installed 5/94

Hewlett-Packard 5890 Gas Chromatograph
DB624 0.53 mm X 30 M columns for Methods TPH-Gasoline and GRO/PVOC and BTEX
FID/PID Detectors
2 Hewlett-Packard 3392A Integrators
OI 4650 Purge and Trap
MPM 16 Auto-sampler

GC-8 Installed 6/96

Hewlett-Packard 5890 II Gas Chromatograph
J&W DB-VRX105 M X 0.53 mm column for EPA 8021, 601 and 602
OI Corp. ELCD/PID Detectors
MS-DOS Instrumentation Control Software
Hewlett-Packard Chemstation and Enviroquant Target Data Management System
Tekmar ALS 2016 Autosampler
Tekmar LSC 2000 Purge and Trap

GC-9 Installed 10/93

Hewlett-Packard 5890 II Gas Chromatograph
2 DB-608 0.53 mm X 30 M columns for EPA 8150, 8080
ECD/ECD Detectors
MS-DOS Instrumentation Control Software
Hewlett-Packard Chemstation and Enviroquant Target Data Management System
Hewlett-Packard 7673A Auto-sampler

GC-10 Installed 6/94

Hewlett-Packard 5890 II Gas Chromatograph
2RTX5 30M X 0.53 mm columns for WDNR DRO and TPH-Diesel
FID/FID Detectors
Hewlett-Packard 7673A Autosampler
Hewlett-Packard 3396 II Integrator
MS-DOS Instrumentation Control Software
Hewlett-Packard Chemstation and Enviroquant Target Data Management System

GC-11 Installed 8/95

Hewlett-Packard 5890 II Gas Chromatograph
J&W DB-624 0.53 mm X 60 M column for EPA 8020, TPH-Gas, GRO/PVOC
FID/PID Detectors
Tekmar LSC 2000 Purge and Trap
Tekmar ALS 2016 Autosampler
Hewlett-Packard 3392A Integrator

GC-12 Installed 8/95

Hewlett-Packard 5890 Gas Chromatograph
2DB-5 30M X 0.32 mm columns for EPA 8150, 8080
ECD/ECD Detectors
Hewlett-Packard 7673A Autosampler
MS-DOS Instrumentation Control Software
Hewlett-Packard Chemstation and Enviroquant Target Data Management System

14.1.3 High Performance Liquid Chromatographs (HPLC)

HPLC-1 Installed 9/91

Waters 712 WISP - Auto Sampler
(2)Waters 501 HPLC Pumps
Waters 680 Automated Gradient Controller with Reference Valve
Waters 486 Tunable Absorbance Detector
Waters 470 Scanning Fluorescence Detector
Vydac 201TP54 column 250 mm x 4.6 mm id for method 8310
Eppendorf CA-30 Column Heater
Hewlett-Packard Chemstation and Enviroquant Target Data Management System
Installed 9/91

HPLC-2 Installed 2/93

Waters 712 WISP-Auto Sampler
(2) Waters 510 HPLC Pumps
Waters 680 Automated Gradient Controller
Waters 486 Tunable Absorbance Detector
LDC FluoroMonitor 4100 Fluorescence Detector
Vydac 201TP54 column 250 mm x 4.6 mm id for Method 8310
Eppendorf CA-30 Column Heater
Hewlett-Packard Chemstation and Enviroquant Target Data Management system

HPLC-3 Installed 9/91

Waters U6K Injector
Waters 510 HPLC pump
Waters 440 Absorbance Detector
ISCO Retriever II Fraction Collector
ISCO Retriever II Diverter Valve
Envirogel GPC 19 X 300 Column for Method 3640
Envirogel GPC 19 X 150 Column for Method 3640
YokoGAWA 3021 Recorder

14.1.4 Total Organic Halide (TOX) Analyzer

Rosemount/Dohrmann DX-20
MC-3 Analyzer Module Micro-coulometric Analyzer
AD-3 Absorption Module
MC-3 Printer

14.2 Inorganic Analytical Instrumentation

14.2.1 Trace Metal Analytical Instrumentation (AA and ICP)

Varian Liberty 100 ICP Optical Emissions Spectrometer — Installed 9/92
SPS-5 Auto-sampler
GRID 386 Model MFP 320 Data Acquisition System

Varian SpectrAA-600.DBQ Atomic Absorption Spectrophotometer — Installed 6/94
Varian VGA 77 Hydride Generator
IBM OS/2 Operating System
Panasonic KX-P1150 Printer

Varian SpectrAA-600z Atomic Absorption Spectrophotometer — Installed 6/94
Zeeman Graphite Tube Atomizer-100
Varian PSD97Z Programmable sampling system
IBM OS/2 Operating System
Panasonic KX-P1150 Printer

14.2.2 General Chemistry Analytical Instrumentation

Barnstead E-Pure Water Purification System

Blue M- Stable Therm Gravity Oven

American Scientific Products- DX-68 Drying Ovens

Ney- Model 525 Series II Muffle Furnace

Milton Roy Spectronic 21 UV/Visible Spectrophotometer

Mettler AT-250 Analytical Balance

Parr- Model 1108 Oxygen Bomb

Pensky-Martens Closed Cup Flash Point Tester

Cleveland Open Cup Flash Point Tester

YSI Model 35 Conductivity Meter

Fisher 925 pH/Ion meter

A10 Tekmar Laboratory Mill

Sartorious LC6200S Top Loading Balance

Sartorious PT-600 Top Loading Balances (2)

Ohaus CT600S Top loading Balance

Precision Scientific 815 Low Temperature Incubator

Orion 860 Oxygen Meter

Fisher 25 pH Meter

Hach COD Reactor

Orbeco-Hellige Turbidimeter

Lachat Quickchem AE Automated Ion Analyzer

14.3 Sample Preparation

CEM MDS-2100 Microwave Digestion System

Environmental Express Max Fil Pressure Filtration Device

Associated Design Manufacturing 3750-SHWF Hazardous Waste Filtration Unit

Branson 8210 Sonicator Bath

Six-foot fume hood (7)

Heat Systems (Misonics) Dual Horn Sonicator Model XL2020.

Environmental Express LE-6000 6 Position Heavy Duty Rotator

Millipore rotary extractor (3)

Millipore TCLP Zero Head Space Extractor (12)

Activated Charcoal Positive Pressure Hood (2).

14.4 Field Sampling Equipment

Isco 2910 Composite Sampler (2)

14.5 Sample Storage

Freezer Storage: Approximately 60 cubic feet in 4 separate, lockable, and temperature-monitored freezers.

Refrigerated Storage: Approximately 231 cubic feet in 7 separate and temperature-monitored refrigerators.

Unrefrigerated Sample Storage: Approximately 393 square feet of shelving for sample storage

15. GLOSSARY TERMS

ACCURACY:

The nearness of a result to the true value. It is the degree of agreement of a measurement, X, (or an average of measurements of the same thing), with an accepted reference or true value, T, usually expressed as a percentage of the reference or true value, 100 (X/T). Accuracy is a measure of the bias in the system.

AUDIT:

A systematic check to determine the quality of the laboratory operation. Audits may be of two basic types:

1) Performance Audits in which quantitative data are independently obtained for comparison with known true values.

2) System Audits of a qualitative nature that consist of an on-site review of the laboratory's Quality Assurance Program and physical facilities for sampling, calibration and measurement.

BATCH DEFINITIONS:

Daily Batch-

The Daily Batch is defined as the number of samples (≤ 20) of similar matrix and the required QC measures, Blank and LCS, extracted or prepared for a particular analysis on a given date. The Daily Batch will be associated with Precision QC measures, Spike and Spike Duplicate, that may or may not be prepared on the same day, but will be prepared within a seven day period or grouping of 20 samples, whichever is less.

Virtual Batch-

The Virtual Batch is a set of 20 or less samples run in a seven day period, all of which are associated with the same precision QC measures. For example:

> Monday: 10 soil samples are received for analysis. A Blank, LCS, Matrix Spike and Matrix Spike Duplicate are run with the Daily Batch and reported.
> Wednesday: 10 more soil samples are received for analysis. A Blank and LCS are run with this Daily batch and reported along with the Matrix Spike and Matrix Spike Duplicate from Monday. This Virtual Batch is complete because it contains 20 samples within the seven day period.

BLANK DEFINITIONS:

Calibration Blank-

An organic or aqueous solution that is as free of analytes as possible and prepared with the same volume of reagents used in the preparation of calibration standards. The calibration blank is used to give the null reading for the instrument response versus concentration calibration curve.

Equipment Blank-

An organic-free aqueous solution that is opened in the field, poured appropriately over and through the sample collection devise, collected in a sample container and returned to the lab as a sample. Equipment blanks are a check of sampling devise cleanliness.

Field Blank-

An organic-free aqueous solution that is transferred from one preserved vessel to another at the sampling site. This serves as a check on reagent and environmental contamination.

Method Blank-

An organic or aqueous solution that is as free of analyte as possible and contains all the reagents in the same volume as used in the processing of the environmental samples. The reagent blank is carried through the complete preparation procedure and is used to correct for possible extraction procedure contamination.

Trip Blank-

An organic-free aqueous solution that is transported to the sampling site and returned to the laboratory without being opened to serve as a check on contamination originating from sample transport, shipping and site conditions.

COMPARABILITY:

An expression of confidence with which one data set can be related to another.

DATA QUALITY:

The totality of features and characteristics of data that bears on its ability to satisfy a given purpose. The characteristics of major importance are accuracy, precision, completeness, representative results and comparability.

DATA VALIDATION:

A systematic process to review data to identify any out-liers, omissions or suspect values to assure the validity of the data to the user. The screening process may be done by manual and/or computer methods and utilize any consistent technique such as limits to screen impossible values or to analyze relationships between new and historical data sets.

ENVIRONMENTALLY RELATED MEASUREMENTS:

A term used to describe all field and laboratory investigations that generate data involving the measurement of chemical, physical or biological parameters of the environment; determining the presence or absence of priority pollutants in waste streams; health and ecological effect studies; clinical and epidemiological investigations; engineering and process evaluations; studies involving laboratory simulation of environmental events; and studies on pollutant transport including diffusion models.

MDL:

The Method Detection Limit is the minimum concentration of an analyte that can be measured and reported with 99% confidence that the value is greater than zero, as performed under ideal operating conditions.

MATRIX SPIKE/MATRIX SPIKE DUPLICATE:

A technique used to provide a measure of accuracy and precision for the method in a given matrix by adding predetermined quantities of analytes prior to sample extraction/digestion and analysis. The spike concentration should be at or near the mid-point of the calibration range, where possible. When performed in duplicate, the relative percent deviation between the MS and MSD is calculated and used to assess analytical precision.

PQL:

The Practical Quantitation Limit is the lowest level to be reliably detected within specified limits of precision and accuracy during routine laboratory operating conditions on environmental samples. The PQL is set at 10 times the standard deviation from the MDL study.

PRECISION:

The measure of mutual agreement between a set of replicate analyses for an analyte without assumption or knowledge of the true value. Precision can be expressed as standard deviation from a set of values or as relative percent difference from a duplicate sample.

QUALITY ASSURANCE:

The total integrated program for assuring the reliability of laboratory data including quality planning, quality assessment and quality improvement efforts to meet user requirements at an economical level. Quality Assurance incorporates procedures for field sampling, sample handling and storage, analytical quality control and document preparation and review.

QUALITY ASSURANCE PROJECT PLAN:

The orderly assembly of detailed and specific procedures by which the laboratory defines how it produces quality data for a specific project or method. The laboratory has one Quality Assurance Program but multiple Quality Assurance Project Plans for various analytical projects.

QUALITY CONTROL:

The routine application of procedures such as blanks, spikes and spike duplicates for obtaining prescribed standards of performance in the measurement process.

RCRA:

The Resource Conservation and Recovery Act.

REAGENT GRADE:

Analytical Reagent (AR) Grade, ACS Reagent Grade and Reagent Grade are synonymous terms for reagents which conform to the current specifications of the Committee on Analytical Reagents of the American Chemical Society.

REPRESENTATIVE RESULTS:

The degree to which data accurately and precisely represents a characteristic population, parameter variations of a sampling point or an environmental condition.

SAMPLE:

A discreet representative part or a single item from a larger group presented to the laboratory for analysis.

DUPLICATE SAMPLE:

Two replicate aliquots taken from the same source for which determination of composition or contamination is requested or required.

REFERENCE SAMPLE:

A sample prepared from an independent standard that is intended as a check of techniques, methodology, equipment, and standards.

STANDARDS:

A known reference concentration of analyte to which environmental samples are compared.

CALIBRATION STANDARDS:

The graduated dilutions of stock analyte solutions prepared to establish the standard curve or calibration curve for a particular analyte.

CALIBRATION CHECK STANDARD:

The verification of instrument response by analyzing a standard prepared from a calibration standard. It is an evaluation of calibration performed concurrently with sample analysis.

STANDARD CURVE:

A graph of the calibration standard concentration versus instrument response for an analyte. The standard curve describes the linear quantitation range for an analyte. The concentration of analyte in an environmental sample can then be calculated from the response factor of the sample.

STANDARD OPERATING PROCEDURE (SOP):

An operation, analysis or action whose mechanics are thoroughly prescribed and documented and which is commonly accepted as the usual or normal method for performing certain routine or repetitive tasks.

SURROGATE:

Organic Compounds which are similar to analytes of interest in chemical composition, extraction and chromatography, but which are not normally found in environmental samples. These compounds are spiked into all blanks, standards and samples prior to analysis and percent recoveries are calculated.

SW-846:

The EPA document "Test Methods for Evaluating Solid Waste - Physical/Chemical Methods".

WATER:

A reference to Reagent, Analyte-Free, Laboratory Pure or ASTM Type II water means any distilled or deionized water which is free of contaminants that may interfere with the analytical test.

16. GREAT LAKES ANALYTICAL'S SCOPE OF TESTS

MASS SPECTROSCOPY

Volatile Organics by GC/MS	624/8260A
Volatile Organics Open Scan	624/8260A
Semi-Volatile Organics by GC/MS	625/8270B/525
Semi-Volatile Organics Open Scan	625/8270B/525

CHROMATOGRAPHY

Halogenated Volatile Organics	601/8010B/502.1
Industrial Solvents	8015A
Aromatic Volatile Organics	602/8021A/503.1
Volatile Organic Compounds	8021A/502.2
Polychlorinated Biphenyl's (PCB's) in Oil	608/8080A
Organochlorine Pesticides & PCB's	608/8080A/505
Chlorinated Hydrocarbons	8120A
Organophosphorus Pesticides	8140
Chlorinated Herbicides	8150B/515.1
Organonitrogen Pesticides	619
Polynuclear Aromatic Hydrocarbons: By HPLC	631/8310
Ethylene Glycol	GLA Method
Toxicity Characteristic Leaching Procedure	1311

LEAKING UNDERGROUND STORAGE TANK (LUST) ANALYSES

Gasoline Range Organics	WDNR-GRO
Diesel Range Organics	WDNR-DRO
Total Recoverable Petroleum Hydrocarbons	WDNR-418.1, 9073
Total Petroleum Hydrocarbons as Gas or Diesel	CA METHOD

METALS ANALYSIS BY 6010A /200.7/7000A series/200 series/Std. Meth 18th Ed.

Aluminum	Cadmium	Lead	Nickel	Thallium
Antimony	Calcium	Lithium	Potassium	Tin
Arsenic	Chromium	Magnesium	Selenium	Zinc
Barium	Cobalt	Manganese	Silver	Zirconium
Beryllium	Copper	Molybdenum	Sodium	
Boron	Iron	Mercury	Strontium	

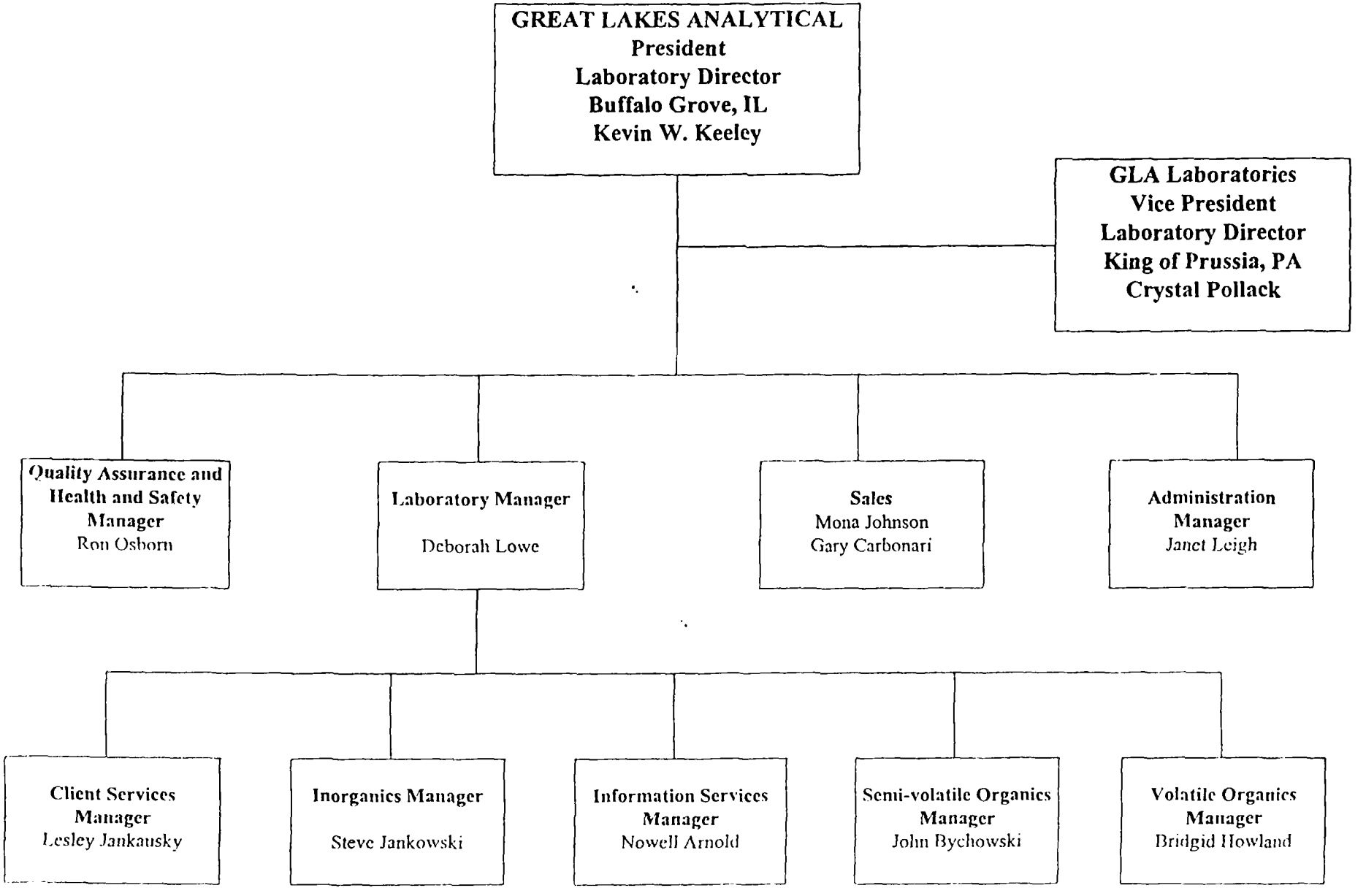
GENERAL CHEMISTRY

Acidity	305.1
Alkalinity	310.1
Biochemical Oxygen Demand	405.1/SM 5210.B
Chemical Oxygen Demand	410.4
Chloride	325.3
Chlorine Demand	409
Chlorine Residual	330.3
Color	ASTM04979-89
Cyanide	9012/335.4
Fluoride	340.2
Cyanide Amenable to Chlorination	9012/335.4
Ignitability - Flash Point Closed Cup	ASTMD93-85
Ignitability - Flash Point Open Cup	ASTMD92-85
Hardness	130.2
Ammonia	350.1
Nitrite	353.2
Nitrate	353.2
Total Kjeldahl Nitrogen	351.2
Odor	ASTMd4979-89
Oil & Grease - Liquid	413.3 / 1664
Oil & Grease - Solid	5520
Oxygen (dissolved)	360.1
Paint Filter test	9095
pH (corrosivity) - Liquid	9040A
pH (corrosivity) - Solid	9045B
pH (corrosivity) - pH paper	9041A
Phenolics (total colorimetric)	9065/420.4
Phenolics (low level detection)	9065
Phosphate (ortho) / Phosphorus	365.2
Reactivity with Acid, Base, Water	SW-846 7.3.2
Reactive Cyanide	SW-846 7.3.3
Reactive Sulfide	SW-846 7.3.4
Specific Gravity	ASTMD1429-86
Ash Content	160.4
Dissolved Solids (filterable)	160.2
Total Solids	160.3
Volatile Solids	160.4
Sulfide	9030/376.1
Sulfate	375.2
Total Organic Halogens (TOX)	9020B
Total Petroleum Hydrocarbons	418.1
Turbidity	180.1

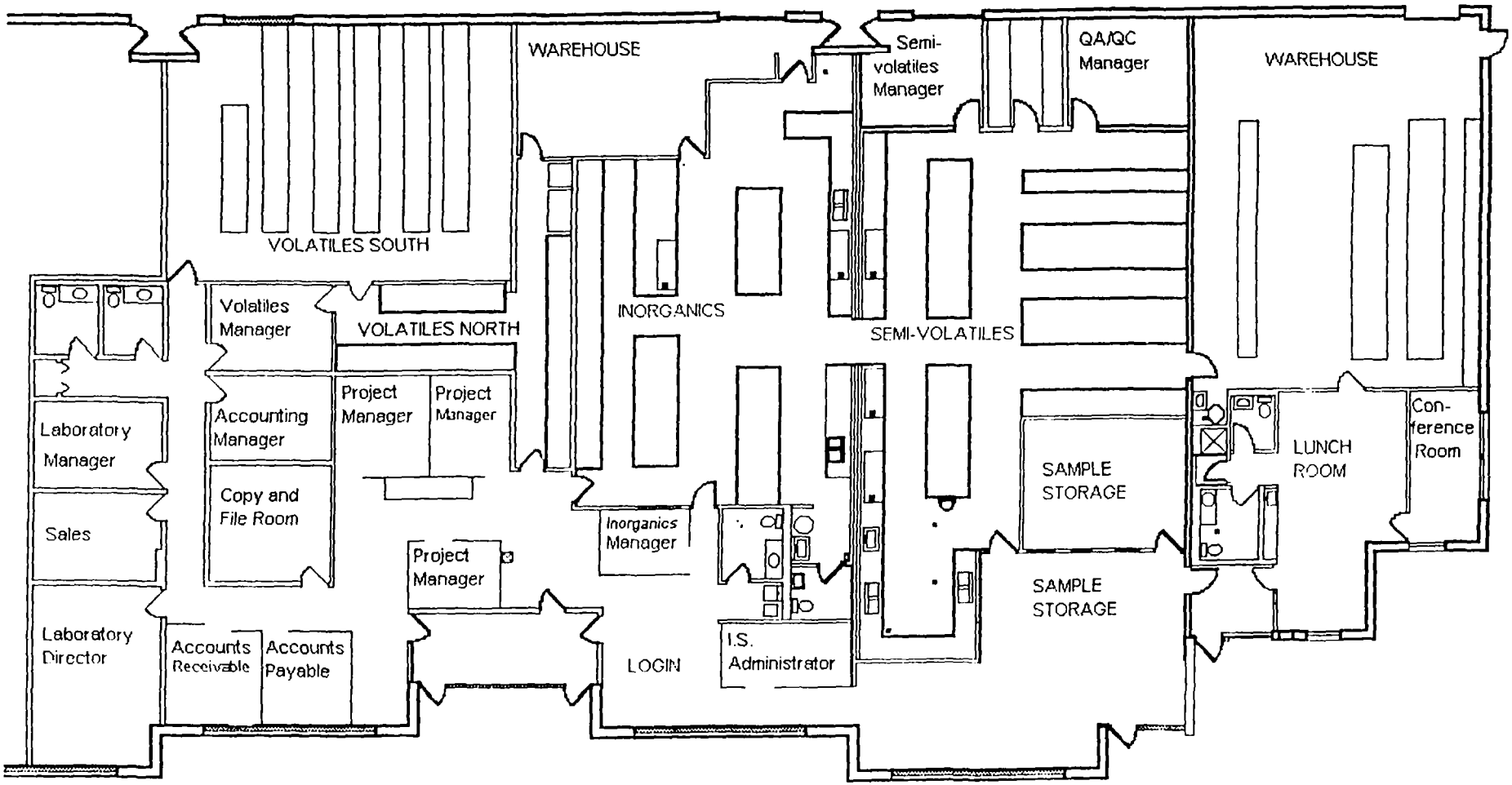
APPENDIX

1. Laboratory Organizational Chart
2. Laboratory Diagram
3. Chain of Custody Report
4. Sample Control Log In Sheet
5. Quality Control Report (MS/MSD)
6. Corrective Action Report

ORGANIZATIONAL CHART



LABORATORY DIAGRAM



GREAT LAKES ANALYTICAL

CHAIN OF CUSTODY REPORT

1380 BUSCH PARKWAY
BUFFALO GROVE, ILLINOIS 60089-4505
(847) 808-7766 FAX (847) 808-7772

Client:

Address:

Report to:

Phone #: ( )
Fax #: ( )

Bill To:

Address:

State & Program:

Phone #: ( )
Fax #: ( )

TAT: 5 DAY 4 DAY 3 DAY 2 DAY 1 DAY < 24 HRS.

DATE RESULTS NEEDED:

TEMPERATURE UPON RECEIPT:

AIR BILL NO

Project:

Sampler:

PO/Quote #:

	FIELD ID, LOCATION	DATE COLLECTED	TIME COLLECTED	SAMPLE MATRIX	PRESERVATIVES	NO. CONTAINERS	TYPE CONTAINERS	SAMPLE CONTROL: CRACKED BROKEN	SAMPLE CONTROL: IMPROPERLY SEALED	SAMPLE CONTROL: GOOD CONDITION	LABORATORY ID NUMBER
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											

RELINQUISHED	RECEIVED	RELINQUISHED	RECEIVED
RELINQUISHED	RECEIVED	RELINQUISHED	RECEIVED

COMMENTS

PAGE OF

GREAT LAKES ANALYTICAL

	Client Name	Project ID	Date Rec'd	Rec'd By	Sample Number	Replicate IDs	Sample OK	Cond. Violated	Matrix	Wet Chem	Metals	GC	GC/MS	Other	TAT	Comment
1																
2																
3																
4																
5																
6																
7																
8																
9																
10																
11																
12																
13																
14																
15																
16																
17																
18																
19																
20																

Client ID	
Project ID	QC TEST

QC Batch	METP 1045 (548)	**Prep Method**	SW-846 3050A
Original		**Prep Date**	06/27/97 10:28
Matrix	*Soil*	**Analysis Method**	SW-846 7421

QC results affect the following production samples:

1527

QC results for Method Blank [1528]

Run Instrument: VARIAN G.F. Spectra A 600

Parameter	Analyzed	Result	RDL	Units
Lead	06/27/97	ND	0.25	mg/kg

Project Manager

Client ID
Project ID QC TEST

QC Batch	METP 1045 (548)	Prep Method	SW-846 3050A
Original		Prep Date	06/27/97 10:28
Matrix	Soil	Analysis Method	SW-846 7421

QC results affect the following production samples:

1527

QC results for Lab Check Standard [1529]

Parameter		QC Result	Pct Recov	LCS/LCSD Limits	RPD	RPD Limits	Spiked Amount	Analyzed	Instru ID
Lead	LCS	50	100	78-110			50mg/kg	06/27/97	GFAA

Project Manager

Client ID	
Project ID	QC TEST
QC Batch	METP 1045 (548)
Original	1527
Matrix	Soil
Prep Method	SW-846 3050A
Prep Date	06/27/97 10:28
Analysis Method	SW-846 7421

QC results affect the following production samples:

1527

QC results for Matrix Spike [1530] - Matrix Spike Duplicate [1531]

Parameter		Original Result	QC Result	Pct Recov	MS/MSD Limits	RPD	RPD Limits	Spiked Amount	Analyzed	Instru ID
Lead	MS	ND	50	100	72-116			50mg/kg	06/27/97	GFAA
	MSD		50	100		0	0-20	50mg/kg	06/27/97	GFAA

Project Manager

GREAT LAKES ANALYTICAL 1380 Busch Parkway • Buffalo Grove, Illinois 60089 (708) 808-7766 FAX (708) 808-7772

Preservation and Weight Deficient Sample
CORRECTIVE ACTION REPORT

Corrective Action Number: _____ Date: _____

Name of person initiating Corrective Action: _____

IDENTIFY SAMPLE PROBLEM
(Weight Deficient Sample, Preservation Deficient Sample)

_____

_____

DISPOSITION OF SAMPLES ASSOCIATED WITH CORRECTIVE ACTION

Client	Sample Numbers	Method of Analysis	Date Due

Use an additional Corrective Action Report form if more space is needed.

TEMPLATES MODIFIED/CLIENT NOTIFIED

_____

_____

_____

Signature: _____

Date: _____

VERIFICATION THAT FINAL REPORT IDENTIFIES PROBLEM

_____

_____

_____

Signature: _____

Date: _____

Dept Manager: _____ QA Manager: _____

Date: _____ Date: _____